Vol. XXIV., No. 3. Sept., 1898. Whole No. 87.

PROCEEDINGS

OF THE

UNITED STATES

NAVAL INSTITUTE.

VOLUME XXIV.

EDITED BY GEO. F. COOPER.

PUBLISHED QUARTERLY BY THE INSTITUTE.

ANNAPOLIS, MD.

COPYRIGHT, 1898, BY GEO. F. COOPER,

Sec'y and Treas., U. S. Naval Institute.

The Lord Baltimore Press

THE FRIEDENWALD COMPANY

BALTIMORE, MD., U. S. A.

The writers are responsible only for the contents of their respective articles.

CONTENTS.

THE DAWN OF NAVAL HISTORY. By Rear-Admiral Stephen B. Luce, U. S. N., ... 441

SUBMARINE TELEGRAPH CABLES IN TIME OF WAR. By Commander C. H. Stockton, U. S. N., ... 451

NOTES ON THE LITERATURE OF EXPLOSIVES. No. XXIX. By Charles Munroe, ... 457

ABSTRACT OF THE LOG OF THE CHRISTOBAL COLON FROM APRIL 8 TO JULY 3, 1898, ... 493

PROFESSIONAL NOTES, ... 501

Ships of War in Action.—The Destruction of the United States Battle-ship Maine.—The Destruction of the United States Battle-ship Maine.—Test of a Six-inch Experimental Krupp Plate.—A Defense of the Torpedo-boat.—Vickers' Quick-fire Field Gun.—The Erosion of Gun Tubes.—The Russian Navy.—Wire-wound Guns.—Lessons from the War to Warship Machinery.—The Largest Floating Dock in the World.—The New Navy Guns.—Colt's New Machine Gun.—Damage to Italian Shipping by Galvanic Action.—Proposals for a Floating Drydock.—A New Method of Making Hard-faced Armor.—Contraband of War.—The Raddatz Submarine Boat.—A New Quick-fire Naval Gun.—The Increase in the World's Principal Navies.—The New Battle-ships.—Ships of War.

OBITUARY.—HERMAN G. DRESEL, ... 563

BIBLIOGRAPHIC NOTES, ... 567

OFFICERS OF THE INSTITUTE, ... 585

SPECIAL NOTICE, NAVAL INSTITUTE PRIZE ESSAY, 1899, ... 586

ADVERTISEMENTS.

THE PROCEEDINGS

OF THE

UNITED STATES NAVAL INSTITUTE.

Vol. XXIV., No. 3. 1898. Whole No. 87.

[COPYRIGHTED.]

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE DAWN OF NAVAL HISTORY.

By Rear-Admiral STEPHEN B. LUCE, U. S. N.

A navy, from the Latin word *navis*, a ship, is the aggregation of vessels of war, including *materiel* and *personnel*, maintained by a state. A navy is designed, primarily, for the preservation of peace by the exercise of that wholesome moral influence inseparable from a judicious exhibition of adequate material force: also for policing the ocean highways, patroling its own coasts; exploring distant seas for the benefit of commerce and navigation; sharing the labors in the fields of science, standing guard on the frontiers of civilization, and for the offensive and defensive operations of war.

Modern navies are maintained essentially in the interests of peace and civilization, and are indispensable instruments in the accumulation of wealth and power; contributing as they do to the security of the state at home and to the conservation of its commerce, its honor and respect abroad.

The word navy has been frequently used to express an assemblage of vessels of any description; but in the absence of a qualifying term, such as mercantile or commercial navy, it is

understood by common acceptation to mean the entire fleet of war vessels belonging to the state, together with all that pertains to their building, repairing, equipping, navigating and fighting.

The word fleet, from the Saxon *flot*, is used in England as synonymous with navy. Thus in the Articles of War of the British Navy, which date back to the time of the Restoration, it is declared by Art. 3rd that "if any officer, mariner or soldier, or other person of the fleet, shall give, hold or entertain intelligence to or with an enemy or rebel," etc. The same term is common to the French Navy: "Depuis peu," says Admiral Paris, "on a adopté les mots 'La Flotte' pour designer la totalité des batiments qui constituents l'effectif des forces navales disponible soit de paix soit de guerre du pays."

Writers in this country, however, especially those of the naval profession, are rather inclined to restrict the word fleet to its technical sense, and attach to it a definite meaning and one equivalent to the French *armeé navale*, "an assemblage of at least twelve line-of-battle ships (*vaisseaux*) or ships of equal military value."

The history of navies reaches far back to the earliest known records. Passing thence to the prehistoric age, one may easily become bewildered in the misty sources of tradition. A sort of mirage pervades that distant horizon which strangely distorts the figures as they come in view. The earth and sky seemed blended in one, and the inhabitants of each meet, as it were, on common ground. It is as if the words of Moses that "the sons of God saw the daughters of men that they were fair; and they took them wives of all which they chose," found literal interpretation. Of such a nature is the story of Jason, who commanded the first naval expedition of which tradition speaks (1263 B. C.). Directed to seek the Golden Fleece in distant Colchis, in the Euxine, he ordered Argus to build a ship of fifty oars, which is named Argo after the constructor. Fifty of the most celebrated heroes of Greece join in the expedition and from the name of the ship are called Argonauts. Mopsus took auguries, and, when the omens were favorable the heroes embarked. Tiphys, to whom the invention of the rudder is attributed, was steersman. To the music of his voice Orpheus added the notes of his lyre, in unison with which the heroes kept time by the dip of the oar.

The voyage is replete with incident, and mortals and immortals associate on the most familiar terms. Among the heroes we find

the names of Castor and Pollux, brothers to that fair Helen whose beauty has been enbalmed in deathless song. On the death of these youths they were placed in the constellation Gemini, and ever after had power over winds and waves. It was for this reason that they were regarded with reverential awe by the mariners of the East, who never failed to invoke their aid in the hour of danger. Their images were borne on some part of the ship or were painted on the side of the prow. That this beautiful tissue has been wrought upon a foundation of sober truth there can be no doubt; and it is curious to observe how one, at least, of the superstitions of the period, or rather the trace thereof, has been transmitted through all these ages even to our own times. After his shipwreck on the island of Melita (Malta) St. Paul departed in a ship of Alexandria, "whose sign was Castor and Pollux." It is this primitive custom of the seaman adorning the prow of his ship with the effigy of some favorite hero, whether of gods or of men, that has come down to the present day. The Goddess of Liberty is a favorite emblem for the figure-head of ships in our mercantile marine; the head of Philip, king of Macedon, carved in wood, graced in years gone by, the "prow" of the frigate Macedonian, and is still in excellent preservation at the Naval Academy; while the intellectual brow of Benjamin Franklin, in effigy, now forms the figure-head of what was, in her day, the finest ship of our navy. How the speculative mind of Lord Macaulay's New Zealander would regard these emblems should they be exhumed in his day, and how curiously the lives of the philosopher, the goddess, and the warrior may be blended in verse, must be left to the Homeric days of the future.

The next naval expedition worthy of note was that undertaken by all the great heroes of Greece (1193 B. C.) for the recovery of Helen, wife to Menelaus, who had been abducted by Paris, son of Priam, king of Troy. The fleet which bore the Grecian hosts to the Trojan shore is fully catalogued and partially described by Homer, and such is his fidelity to truth that he is often quoted by writers of antiquity as an authority for historical facts.

> Great Agamemnon rules the numerous band.
>
> . . . . . .
>
> High on the deck the King of Men appears
> And his refulgent arms in triumph wears;
> Proud of his host, unrivall'd in his reign,
> In silent pomp he moves along the main.

The following portrait, drawn as it is by the hand of a master, will answer for any great leader of any age or clime, more particularly if we render it in a moral rather than in a physical sense.

> The King of Kings, majestically tall,
> Towers o'er his armies and outshines they all.
>
> . . . . . .
>
> Great as the gods th' Exalted Chief was seen,
> His strength like Neptune, and like Mars his mien.
> Jove o'er his eyes celestial glories spread,
> And dawning conquest played around his head.

The largest vessels of the fleet were those of Boeotia.—

> Full fifty ships they send and each conveys
> Twice sixty warriors through the foaming seas.

The smallest were those of the division commanded by Philoctetes.

> Seven were his ships; each vessel fifty row.

These latter were known as pente-konters. The fleet numbered altogether twelve hundred vessels. They were so light as to be readily hauled up on the beach, generally stern first; were propelled by oars and, when the wind was favorable, by sails, and are frequently described as of a "sable hue."

> "Who landed first lay highest on the shore."

That a punishment similar to "flogging through the fleet," at one time admitted by the severe discipline of the British Navy, was not unknown to the Greeks may be fairly inferred from the following: Thersites, "loquacious, loud and turbulent of tongue," for discoursing in a highly insubordinate strain of the commander-in-chief, is severely reproved by Ulysses:

> With indignation sparkling in his eyes,
> He views the wretch and sternly thus replies.
>
> . . . . . .
>
> "Gods! let me perish on this hateful shore
> And let these eyes behold my son no more;
> If, on thy next offence, this hand forbear
> To strip those arms thou ill deserv'st to wear;
> Expel the council where our princes meet,
> And send thee, scourg'd and howling through the fleet."

Helen, standing on the Trojan walls, names over to old Priam the heroes from beyond the Aegean Sea, as they are now seen

on the adjacent plain, and sadly bemoans the absence of her brothers, whose fate has been already told.

> Yet two are wanting of the numerous train,
> Whom long my eyes have sought, but sought in vain.
>
> . . . . . .
>
> Perhaps the chiefs, from warlike toils at ease
> For distant Troy refus'd to sail the seas;
> Perhaps their sword some nobler quarrel draws,
> Asham'd to combat in their sister's cause.
> So spoke the fair, nor knew her brothers' doom,
> Wrapt in the cold embraces of the tomb:
> Adorn'd with honors in their native shore,
> Silent they slept, and heard of wars no more.

Translated from an earthly grave, tradition tells of their glistening soon after from their bright spheres above, keeping their ceaseless vigils over the seaman in his perils by the sea.

But it is time to leave these scenes and speed our way down the course of time. The seamen of Gennesareth were blessed in seeing a brighter light than ever streamed from heavenly constellation. They were taught to invoke a stronger power than that of Castor and Pollux, and in their extremity to cry, and not in vain, "Save, Lord, or we perish!" Since that blessed day the mariner has, in deed and in truth, looked to Heaven to guide him on his way along the treacherous deep. And what navigator, so cold of heart, so undiscerning as to contemplate the "spangled heavens" and see, in fancy, that great system of spherics, on the correct solution of which his art and his safety alike depend, without a feeling of awe, mingled with admiration, for the grandeur of the design and the inconceivable wisdom of the Great Architect of all.

The history of navies, or of naval architecture, does not commonly go back to the Ark; and yet there is a curious fact to be noticed with regard to the dimensions of that structure as given by the Divine Architect. About 4000 years ago God said to Noah, "Make thee an ark of gopher* wood." "The length of the ark shall be three hundred cubits, the breadth of it fifty cubits and the height of it thirty cubits." † In terms of breadth

*Gopher wood, or cypress, a light and durable wood, and much used by the Phenicians for ship-building.

†Allowing 21 inches to the cubit gives: length, 525 feet; breadth, 87½ feet; depth, 52½ feet; and a little over 19,000 tons. The ark had three decks. She was not, in a modern sense, a ship, but rather an immense floating box with great capacity and stability.

this gives six times the breadth for the length, and six-tenths of the breadth for the depth. In the early part of the seventeenth century a Dutch merchant named Peter Jansen caused a vessel to be built on the same proportions. Though much laughed at by the community in which he lived, he found that his vessel would carry about one-third more than any other with which he could compare her, and yet employ no more hands. The best line-of-battle ships of the French at the beginning of the present century (the most scientific ship-builders of that day) did not quite reach four times their beam for their length. Our own Ohio, considered the finest line-of-battle ship of her day (1820), was 198 feet long, 50.4 feet beam and 40.6 feet deep, less than four breadths in length. The Great Republic,* however, one of the most perfect specimens of naval architecture of modern times, was 325 feet long, 53 feet beam and 39 feet deep. Allowing for overhang, etc., will bring the general proportions of this splendid ship very nearly to those of the ark and a little over one-fifth of the tonnage—proportions which have, only at this late day, become recognized as the best for wooden sailing ships.

It has been finely observed that on the shores of the Mediterranean were the four great empires of the world: the Assyrian, the Persian, the Grecian and the Roman. "All our religion, almost all our law, almost all our arts, almost all that sets us above savages, has come to us from the shores of the Mediterranean." It was on the eastern shores of that sea, too, that commerce and navigation took their rise and where navies had their birth. Ocean commerce and navigation are in a certain sense the parents of navies, and it will be found in the history of the world that where nations have cultivated and fostered the former, the latter have sprung into existence as a natural sequence, the one giving wealth and power to the possessor, the other position and influence. "Commerce follows the flag" may be more properly rendered, "The flag follows commerce."

About 1635 years B. C. the dying patriarch Jacob gathered for the last time his many sons about him. His bodily eye was dim with age, but with the unfading eye of faith he looked into the great womb of futurity and mingled prophesy with his last blessing: "Zebulon shall dwell at the haven of the sea; and he shall be for an haven of ships and his border shall be unto Sidon."

* Built by Mr. Donald McKay, of Boston, in 1853, for the California trade.

It was indeed from Phenicia, a narrow strip of land lying between the mountains of Lebanon and the sea, that the earlier mariners sprung. Rich in all the products favorable to maritime enterprise and bordering on a vast empire, Sidon, and afterwards Tyre, its principal ports, became the great commercial centres of the world. Stimulated by success, the Phenicians* pushed their enterprise westward, founding colonies and establishing trading posts wherever lured by the hope of gain. The inspired writers afford abundant evidence that they were not ignorant in those days of the value of foreign commerce. After telling of the great wealth of Solomon the sacred narrative continues: "It was nothing accounted of in the days of Solomon, for the King had at sea a navy of Tharshish with the navy of Hiram: once in three years came the navy of Tharshish, bringing gold and silver, ivory, apes and peacocks, so King Solomon exceeded all the kings of the earth for riches and for wisdom." The navies† of the two kings were united in distant voyages, partly to the western coast of the Mediterranean as far as Spain, vaguely described under the name of Tharshish, and partly from the two ports of the Red Sea to the shores of Arabia and possibly of India. The latter navy traded chiefly to Ophir. Again in Chronicles: "And Hiram sent him by the hands of his servants ships and servants that had knowledge of the sea: and they went with the servants of Solomon to Ophir and took thence four hundred and fifty talents of gold and brought them to King Solomon" (B. C. 1015 to 975). The prophet Ezekiel gives a glowing description of the wealth and importance of Tyre. The picture there drawn is heightened in effect by the lofty tone of the prophet enriched by the imagery of the eastern tongue: "O Tyrus that art situate at the entry of the sea, which art a merchant of the people of many isles. Thus saith the Lord God: 'Thy borders are in the midst of the sea, the builders have perfected thy beauty. They have made all thy ship boards of fir trees of Senir: they have taken cedars from Lebanon to make masts for thee. Of the oaks of Bashan have they made thine

* *Phenicians*, from the Celtic words *foene* and *oice*, *i. e.* "ploughers of the sea."—Jenks' Scripture Gazetteer. Plausible as this may appear, it is incorrect. The Celts knew nothing of the Phenicians in the Homeric times, and Homer uses the word. They were the people of the "purple age." See Athons Class. Dic.

† Not used in the sense now common, but rather to express a number of ships.

oars: the company of the Ashurites have made thy benches of ivory, brought out of the isles of Chittim.'" "Fine linen with broidered work from Egypt was that which thou spreadest forth to be thy sail: blue and purple * from the isles of Elishah was that which covered thee. The inhabitants of Zidon and Arvad were thy mariners: they, wise men, O Tyrus, that were in thee were thy pilots," etc. It is from Sidon and Tyre—Tyre, the modern town of Soor or Sur, about thirty miles to north'ard of Acre in Palestine—that we trace, as from original sources, navigation, seamanship and all that pertains to the mariner's art. From Tyre the Phenicians established a colony at Carthage, which in its turn became the great commercial centre of the world, and in its day (B. C. 878 to 480) the greatest city of Africa and the rival of Rome itself. Still passing westward, navigation reached Cartagena and the Pillars of Hercules, great nations springing up in its course. Greece held her empire for a while to be succeeded by Imperial Rome. Venice from her dank marshes, her scattered isles and salt trade became mistress of the seas and monopolized the ocean trade, only to be disputed in time by the Genoese.

Passing thence to Portugal and Spain, to Holland and Britain, till finally, gathering strength and boldness, navigation shot out over the vast wilderness of unknown waters to find new shores for still greater empires: opening out new fields of commerce, discovering riches undreamed of by Avarice, effecting a revolution in navigation and in ship-building, and at one great stride bringing mankind to a degree of culture and refinement—a higher civilization, with all its attendant blessings, which could only have been anticipated by Prescience itself.

From that blessed night when, under the soft Syrian skies, the wondering shepherds heard angel voices heralding our Lord, no event has been so pregnant of results to the world's history as that which transpired at the little port of Palos in 1492. On the third day of August of that year the Santa Maria, bearing the flag of the High Admiral, Columbus, and leading the Pinta and Nina, sailed thence and marked a new era in the world's age. Thus the colony of the Phenicians in its turn sends out its navy to found new colonies. It is when taking this view of the tide of events that we are impressed with the truth and beauty of Bishop Berkely's celebrated line—

Westward the course of empire takes its way.

* Hence the name of Phenician from the Tyrrian or purple dye.

In this great onward march navies have been the untiring pioneers, showing that the paths of the seas have ever been the paths of human progress and civilization. As the discovery of new shores rewarded the adventurous boldness of the seaman, new colonies sprung up, and the same navies that had led to their foundation would be there to protect and foster their young energies—securing the merchant in the peaceful pursuit of legitimate trade and protecting his argosies from plunder on the seas. Such has been the grand rôle of navies. Such it continues to be. Well had it been for mankind, humanly speaking, could their sphere have been limited to the fields of peaceful commerce. The course of empire is unhappily marked by a trail of blood. Navies have, but too often, been prostituted to the uses of unscrupulous princes for the subjugation of weaker states; for the acquisition of wealth and territory by a species of national or state piracy, and not infrequently by even so-called Christian powers as the *ultimo ratio regum*.

The ocean commerce of the Phenicians constituted the great nursery of seamen, and led subsequently to the formation of the powerful navy of Carthage. Phenician seamen were employed as mercenaries and were to be found in no inconsiderable numbers in the Persian and other fleets. But there was another kind of pursuit which, while it gave rise to a race of bold and practised seamen, was itself the active and immediate cause of the establishment of navies. It was piracy.

The Aegean sea was ploughed by the piratical galley of many an isle; and many a Grecian chief owed his wealth to that source of livelihood. Menelaus, in the Odyssey, displays his treasures and boasts of the manner in which they were gained. Piracy, so far from being deemed dishonorable, was rather reckoned to one's credit. But to those who were not pirates this mode of acquiring property was, at the least, inconvenient. Thus Thucydides, in speaking of the earlier Greeks, remarks that "Minos, king of Crete, was the most ancient of all with whom we are acquainted by report, that acquired a navy and swept piracy from the sea, as much as he could, for the better coming in of his revenues."* The Cretan navy became formidable in

* Minos was a Phenician. He is recorded in history as having created a large naval power and of having established in Crete the most ancient recorded political system, calculated to combine the liberty of citizens with regular government; it was the model of Lycurgus' subsequent institutions for Sparta (Jenks' Scripture Gazetteer, p. 76). Minos, according to Thucydides, died about three generations before the Trojan war, or, according to modern historians, 1006 years before Christ.

its day, but having fulfilled its ends was subsequently overshadowed by the more powerful fleets of Athens and Peloponnesus.

Of other navies we have hints in the following: "The most ancient sea fight with which we are acquainted," writes Thucydides (B. C. 403), "was fought between the Corinthians* and the Corcyraeans." "For the Corinthians having their city situated on an isthmus had always possessed an emporium and obtained the title of 'wealthy,' and when the Greeks began to make more voyages, having got their ships, they put down piracy." "And the Ionians afterward had a large navy in the time of Cyrus, the first king of the Persians, and Cambyses his son; and while at war with Cyrus, commanded the sea along their coast for some time."

"Polycrates also, tyrant of Samos in the time of Cambyses, having a strong fleet, both made some other of the islands subject to him and took Rhenea and dedicated it to the Delian Apollo. And the Phoceans, while founding Massalia (Marseilles), conquered the Carthaginians in a sea-fight."

"These were the strongest of their navies and the last that are worth mentioning established in Greece before the expedition of Xerxes" (Thucydides).

This brings us down to the period of Greek civilization, when it had reached its highest level, and when the navies of Greece had attained their most thorough state of efficiency.

It will be our endeavor at some future time to give brief sketch of the Athenian navy, one of the most notable of all the navies of antiquity.

* The Corinthians were the first people of Greece who became a maritime power. Corcyra, from being a colony, became the rival of Corinth and so continued for about two centuries, till Athens joined Corcyra and assumed for herself the dominion of the seas.

[COPYRIGHTED.]

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

SUBMARINE TELEGRAPH CABLES IN TIME OF WAR.

By Commander C. H. STOCKTON, U. S. N.

Though the recent hostilities with Spain were so short in duration, and so restricted as to opportunities for the settlement of important questions of war and international law, there was, nevertheless, one matter which assumed an importance throughout the entire period, and that was the question of international telegraphic communication by means of submarine cables in time of war.

From the time of the cutting of the Manila cable by Admiral Dewey, until the removal of the censorship of the communication by cable between Havana and Europe, it was a matter always under consideration by the belligerents, and far from being ignored by the neutrals concerned.

It was, of course, not entirely a novel question in the works and discussions upon international law, but it was a question which, though meagre as to usage, is constantly extending in its geographical area in the world as well as increasing in importance, both for peaceful and warlike purposes.

The general question of the international protection of submarine telegraph cables on the high seas and elsewhere led, in the past, to various general conferences upon the subject in Europe; the last one being held in Paris, at which was concluded a convention on March 14, 1884, the ratifications of the signatory powers being exchanged on April 1, 1885, and the date arranged for the agreement or convention to go into effect was May 1, 1888. To this convention the United States was a party, the Hon. L. P. Morton being our representative. The convention treated of the laying and protection of telegraphic cables in time of peace, Article XV of the convention reading as follows:

"It is understood that the stipulations of this convention shall in no wise affect the liberty of action of belligerents."

Concerning this article, Dr. Macdonell, an English lawyer of recognized standing, in a recent lecture, says:

"The 15th article of the Submarine Cable Convention expressly reserves the rights of belligerents, which, I take it, include cutting or injuring any cable likely to be useful to an adversary, however injurious such interruption may be to neutrals. This is confirmed by referring to the *procès verbal* of the proceedings. I find that the Belgian delegate, M. Orban, stated that 'as he read the article, the text recognized the liberty of action of the belligerent, and, by implication, his right to cut submarine cables, even those that land on neutral soil.' Another representative at the conference gave formal intimation, at an early stage in the proceedings, that the convention for the protection of submarine cables should have no application except in time of peace. At the time of signing the convention, Lord Lyons presented a declaration in the name of the English government to the following effect: 'Her Majesty's Government understand by Article 15 that in time of war a belligerent power which has signed the convention will be as free to act in regard to submarine cables as if the convention did not exist.' M. Orban, the Belgian delegate, added a declaration to the same effect: 'The Belgian Government, by the medium of its delegates at the conference, has maintained that the convention had no effect on the rights of belligerent powers; these rights would be neither more nor less extensive after the signing of the convention than before.'"

"There is little doubt that it was the opinion of the signatories of the convention of 1884 that a belligerent might freely cut submarine cables—might, for example, sever the connection between England and her colonies and foreign possessions without just cause of offence."

So far as the usage is concerned, up to the time of our war with Spain, it is confined, as far as I can ascertain, to the Franco-German war, the war between Chile and Peru, and the civil war in Chile. In these cases cables were cut both within the territorial waters of the belligerents and in ex-territorial waters or the high seas. The belligerent action of the late war in cable-cutting, which was wholly upon our part, did not limit the cutting, or the attempts to interrupt the communication, either to the territory or to the property of the belligerent concerned.

There can be little doubt as to the right of a belligerent to

cut, destroy or interfere with a submarine telegraph cable or terminal station, no matter by whom owned, in the territory, land or water of the enemy, whenever military necessity or convenience requires it. The belligerent concerned is the sole judge of this necessity and of the nature of the interference which he proposes to create. Such an act is, of course, a belligerent act, and neutrals participate in it at their risk, as when they enlist in a belligerent's army or navy.

It is generally recognized, certainly by the United States, that under certain circumstances and conditions, materials for the construction of telegraphs are contraband of war. Submarine cables, if found ashore in belligerent territory, or afloat, bound for a belligerent destination, as an enemy's port or fleet, would certainly be liable to seizure as material for the construction of a telegraphic communication, and hence contraband of war. If it then can be considered contraband of war on its way to a hostile destination on the high seas, as material or a component part only of a working telegraph, how much more does such a cable become contraband of war when it is in working order, actually conveying aid, information and, possibly, money to a belligerent or belligerent country in time of war.

Much could be and has been said about the commercial importance and general usefulness and harmlessness of telegraphic communication by cable to neutrals and to innocent persons of both belligerents in war time, but such usefulness must give way to the stern necessities of war. War, as our late hostilities prove, is not a benevolent measure, nor can it be successfully used as a means of immediately conveying benevolence or charity. That, ultimately, it may become of service in that direction there is, I think, but little doubt; but during the active operations, convenience and commerce must, when necessary, step aside. There is no doubt also, to take an instance, of the convenience and utility and even humanity of a system of buoyage and lights ashore and afloat for the purposes of navigation and safety; yet, in times of war, the extinction of sea-coast and harbor lights and the removal of buoys is directed by belligerents and submitted to by neutrals without question as matters of military necessity and right.

Besides the contraband character of the material of a telegraphic cable, in use or *en route*, as an essential element of belligerent communication which renders it liable to seizure anywhere out of neutral territory, there is another phase of this

question, and that is in regard to the nature of the service afforded by such a communication by a neutral proprietor to a belligerent.

This service is in the nature of both an evasion of a blockade, and, what has been termed of late years, of unneutral service. It does not matter in this phase whether the cable be privately or state-owned so far as the technical offence is concerned, though the gravity and consequences are naturally much more serious in the latter case. Let us take, as an instance, the case of a blockaded or besieged port, as Havana and Santiago were during the late hostilities. The communication of information, or of dispatches, or of means of assistance which can be made by such means, is an unneutral service, and would resemble also the violation of a blockade by a neutral vessel carrying dispatches, the capture of which upon the high seas outside of territorial jurisdiction would be a justifiable and indisputable act of war.

Extend this to a country or port not blockaded or besieged, and you would yet find the cable, owned, let us presume, by a neutral, the means of performing the most unneutral kind of service, of a nature which, done by a ship, would most properly cause its seizure, condemnation or destruction by the offended belligerent.

There are, however, other conditions existing besides that of a cable leading by way of, or from, a neutral country to that of a belligerent. Such is the case of a cable laid between two neutral ports, link of a chain, perhaps, reaching from a belligerent to his colony or foreign possessions. In this case there is little doubt but that the cable should be exempt from seizure or attack —the transit of continuous hostile or belligerent messages is too slight a matter compared with the gravity of interruption to allow such a cable to be tampered with. The Institute of International Law, in a session held in 1878, adopted the conclusion or declaration of opinion "that any submarine telegraphic cable that united two neutral territories should be held inviolable." This will doubtless be firmly established in time to come as a sound rule, as is both reasonable and proper.

If, however, there should be a neutral station or landing place interposed between the termini of a cable, both termini being on territory of the same belligerent, the safety and use of the cable could, perhaps, be assured by a censorship on the part of the neutral as to messages. A belligerent to whom such a cable is of essential military importance should provide for this contin-

gency by laying a cable or loop outside of the neutral territory, if the entire distance is not beyond the telegraphic range of the instruments. At all events, one belligerent is not unreasonable in demanding that the neutral should not permit messages from the other belligerent passing through neutral territory, of a nature injurious or disadvantageous to himself. It is not unlike the transit of troops through neutral territory; even if such be granted alike to both parties, it may still work injuriously to one of them. If, however, neither belligerent offered objection or if mutual consent was definitely given, permission to use the cable indiscriminately by both belligerents could be properly allowed by the neutral country or by the neutral cable company.

When possible cable communication generally should, of course, be kept open for commercial or other innocent intercourse, and in many cases a government censorship can meet the circumstances and requirements of the war and prevent injury to a belligerent. It is gratifying to know that to this solution of the question the practice of the United States in the late war greatly contributed.

In conclusion it may be interesting to state the circumstances at Manila, after the action of May 1st:

The cable from Manila to Hong Kong was owned and controlled by an association of English and Danish companies and subsidized by the Spanish government. After the battle of Manila Bay, Admiral Dewey asked for its use and agreed to its use also by the Spanish if he could send his dispatches. This the Governor-General of the Philippines refused, and hence Admiral Dewey cut the cable. The cable company refused to send Admiral Dewey's dispatches through Hong Kong, notwithstanding his offer to pick up the cable and provide the instrument for its use in Manila Bay.

In this case the right to cut the cable was undoubted. The common use of the cable by both Admiral Dewey and the Governor-General, if agreed upon by both parties, would have placed the cable in a neutral position—both parties agreeing. The use of the cable by Admiral Dewey alone, or by the Spanish alone, would have placed the cable company in the position of aiding one side at the possible expense of the other. The use of the cable at Hong Kong station was, in all probability, common to both sides, and without objection from either belligerent. The fact that the cable was subsidized by the Spanish government

made it more than ever a belligerent instrumentality, subject to seizure or disabling by the other belligerent, but doubtless also made the cable company feel that it would be especially unwise to lend aid against the subsidizing power.

Authorities.—Dr. Macdonnel, Journal Royal United Service Institute, No. 246, p. 916; Perels, Manuel de Droit Maritime International, pp. 75, 77, 217; Fiore, Nouveau Droit Inter. Public, p. 22; Owens' Declaration of War, pp. 182, 382; Manual of International Law, Ferguson, sections 123, 124; Treaties and Conventions of the United States, 1776 to 1887, pp. 1176, 1187.

[COPYRIGHTED.]

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NOTES ON THE LITERATURE OF EXPLOSIVES.*

By CHARLES MUNROE.

No. XXIX.

The "Twenty-first Annual Report of Her Majesty's Inspectors of Explosives" shows that the growth of the trade in explosives in Great Britain continues to increase notwithstanding the restrictions and governmental supervision imposed by the Explosives Act, five new factories having been licensed during the year and seven applications for licenses being still pending, while seven new magazines were licensed and nine others pending. The areas of the existing factories have also been enlarged so that, for instance, the site occupied by the Nobel's Explosive Co. Ltd., at Ardeer, is four times as large as it was when the Act was passed, while the number of buildings occupied by the company has increased in a similar proportion.

There was imported during the year—

Amorces	2,540	pounds.
Bellite	44,250	"
Blasting gelatine	27,500	"
Carbonite	579,000	"
Cooppal's powder	3,950	"
Dahmenite A.	26,450	"
Dynamite	179,000	"
Emerald powder	5,000	"
Fulminate of mercury	9,400	"

*As it is proposed to continue these notes from time to time, authors, publishers and manufacturers will do the writer a favor by sending him copies of their papers, publications and trade circulars. Address, *Columbian University, Washington, D. C.*

Gun-cotton	56	pounds.
Gunpowder	66,528	"
Gelatine dynamite	416,650	"
Fireworks	556,920	"
Matagnite gelatine	57,050	"
Normal smokeless powder	178	"
Normal sporting powder	6,215	"
Pigou's smokeless sporting powder	1,000	"
Tonite	1,862	"

and 9,780,000 detonators.

The total number of factories now in operation in Great Britain is 139, making 53 different kinds of explosive materials, yet but one person was killed during the year from an accident occurring during manufacture. The total list of accidents is as follows:

SUMMARY OF ACCIDENTS.

	Accidents causing loss of life and bodily injury.			Accidents not causing loss of life or bodily injury.	Total number of Accidents.
	No. of Accidents.	No. of Killed.	Persons Injured.		
Manufacture	20	1	25	26	46
Keeping	6	6	4	3	9
Conveyance	1	—	2	1	2
Use and miscellaneous	76	26	80	1	77
Total	103	33	111	31	134

Under use and miscellaneous are included all accidents which occurred in the use of explosives and immediately connected therewith; also accidents in thawing nitroglycerine preparations, and others arising from miscellaneous causes not within the prohibitions of the Act. In short, this group comprises all accidents occurring under circumstances not immediately controlled by the Act except the non-fatal, purely mining accidents with gunpowder under the Inspectors of Mines. It is natural to expect that the larger number of accidents will occur in use, as the explosives here get into the hands of many careless and untrained persons who are frequently free from supervision; yet numerous as the casualties for the year are, the number of killed was considerably below, and of wounded slightly below, the average for the preceding ten years.

As we have before remarked, these statistics would have greater value if accompanied by a statement of the amount of explosives produced and the amount of explosives consumed each year in the territory covered by the Act, and we are inclined to believe that if this were done the beneficent operation of the Act would be more strikingly shown.

An analysis is made of these casualty statistics on the basis of the number of factories in operation and persons employed, and it is pointed out that for the seven years immediately preceding the Act there was recorded an annual average of 39.5 deaths as based on the imperfect, non-compulsory returns from 55 factories only, whereas the average for the past ten years (there being now 139 factories and over 10,000 persons employed) the average for deaths is 5.1 (or about one-twentieth per cent. of the total number employed), and for injured 18.6 (or about one-fifth per cent. per annum). The saving in life is the more notable when it is recalled that a large proportion of the new factories established since the Act went into operation deal with entirely new classes of explosives and therefore with new forms of risks.

During the year the following substances were added to the list of authorized explosives: *Normal sporting powder*, consisting of nitro-cotton thoroughly purified, mixed or incorporated with potassium or barium nitrates or both of them, and paraffin or vaseline, both free from mineral acid, the whole gelatinized by a suitable process, grained and polished with or without graphite. *German spills*, consisting of cylindrical cases of paper, one-half charged with fuse composition, consisting of potassium nitrate, sulphur and charcoal, the other half containing a charge of gunpowder, the whole composition and gunpowder not to exceed two pounds to the gross, primed at one end with touch paper, and at the other with mealed gunpowder, or primed at both ends with mealed gunpowder. *Pettinger's electric fuses*, consisting of a cylinder of wood or other suitable material, containing two insulated copper wires, the ends of which, whether or not connected by means of a fine wire of platinum or other suitable material, are embedded in a priming composition, consisting of an intimate mixture of potassium chlorate, native antimony sulphide, copper subsulphide or subphosphide, silver (precipitated), plumbago, charcoal and bismuth. *Pettinger's electric detonator fuses*, consisting of Pettinger's electric fuses as above described and having attached thereto a detonator. *Kynite*, consisting of

not more than 27 parts by weight of thoroughly purified nitroglycerine (with or without the addition of not more than half a part of sulphuretted benzol), and with or without such other ingredient as may from time to time be sanctioned by a Secretary of State, uniformly mixed with not less than 75 parts by weight of a pulverized preparation, consisting of wood meal, not less than 40 parts, nitrates of potassium, barium, and sodium (or either of them), not more than 36 parts, and carbonate of sodium or calcium (or either of them), not more than half a part; such preparation to be sufficiently absorbed when mixed in the above proportions to prevent exudation of the nitroglycerine. *Oven blowers*, consisting of a short cylinder of paper dubbed at one end and charged with gunpowder, and having inserted in the other end a piece of quick-match encased in paper, projecting about four and one-half inches from the cylinder, the end of which is choked and tied, the projecting end of the quick-match being dubbed and coated with sulphur and the cylinder being afterwards flattened in a cracker mill.

Dr. Dupré's report is as usual full of interesting matter. It will be recalled that after investigation the amount of composition which was permitted in amorces was limited to .07 grains per amorce, it having been determined that this was a quantity which would prevent explosion *en masse*. An explosion which occurred at Kingston-upon-Hull in September in which several gross of boxes were destroyed gave rise to considerable apprehension in this regard. Fortunately a number of boxes from the same consignment and of the same manufacture were recovered from the shop after the explosion and examination showed that although the *average* proportion of explosive matter contained in the amorces was within the limit laid down, a not inconsiderable number of the individual amorces exceeded, and some very largely exceeded, this limit. Previous experiments had clearly established the fact that the safety of these amorces depends not so much on the average proportion of explosive matter contained in 1000 amorces as upon the fact that no individual amorce should exceed this proportion, since the larger amorce plays the part of a detonator, capable, if it contains too great a proportion of explosive matter, of exploding the whole, and this accident but confirms this deduction from the results of experiments.

Among the results of tests Dr. Dupré reports that 10 out of 113 samples of gelatine dynamite No. 2 and matagnite gelatine were rejected, four from failure to stand the heat test and six on account of exudation. The failure to stand the heat test may perhaps be due to the injurious effects exercised by some kinds of wood meal, but it is difficult to understand why, considering the absorbing power of the wood meal present in the gelatine dynamite, exudaton should be more prevalent among samples of gelatine dynamite than among blasting gelatine.

The tests of five samples of American smokeless powder are recorded. "Four of the powders, American E. C., Hazard, Dupont, and Kings, closely resemble well-known English powders, consisting in greater part of nitro-cellulose, mainly of the soluble variety, with the addition of some nitrate of barium and potassium. The two first stood our heat test perfectly, and were well manufactured, the rest passed the heat test indifferently well, while the fourth stood the test for 6½ minutes only.

"The so-called 'gold dust' differed, however, widely from any of our English powders; it consisted of picrate of ammonium, picrate of potassium, picric acid, and bichromate of ammonium. It was exceedingly violent in its action and appeared to be a rather dangerous powder to use in a shotgun."

The new explosives examined during he year were *bonnite*, which, like Kolf's powder, consisted of a mixture of different nitro-compounds, most of which are difficult to purify effectively. The first sample submitted was satisfactory as to its physical character and temperature of explosion, but it stood the heat test but two minutes on account of insufficient purification. The second sample passed the preliminary tests successfully, but lacked sufficient chemical stability to successfully resist prolonged exposure to 90°-95° F., and it too was rejected. *Ripplene*, consisting of a nitrate mixture containing kerosene shale, was favorably reported on, subject only to the condition that the shale should be free from pyrites. *Patent blasting powder No. 1*, consisting of ordinary gunpowder mixed with a salt to prevent the production of flame on explosion, was also favorably reported on, as it possessed the required chemical stability.

Among the "Accidents" are two occurring in the manufacture of ballistite. In the first some sheets caught fire as they were passing through the rolls; in the second a small quantity exploded

in the press. The latter accidents have been thought due to the heat developed by the too sudden compression of the air in the interstices of the paste, but in this case the plunger was being withdrawn, and the accident is attributed to friction between the plunger and inside of the cylinder, where some accumulation of the paste is unavoidable.

The report on the fire occurring at the works of the Cotton Powder Co., Limited, near Faversham, on March 1st, develops the interesting fact that some 5000 to 6000 pounds of gun-cotton in water, which was exposed to the full effect of the fire, was practically uninjured, although in some cases the vats and vessels containing it were burnt away, and an even more important fact was the burning away inexplosively of over 3000 pounds of gun-cotton, containing about 30 per cent. of water, made for the War Office, and stored in barrels of 27¾ pounds each.

The most fruitful source of accidents in use has been during ramming, either from the use of improper tools or the application of undue force. As usual a preponderance of these accidents occurred in frosty weather when, owing doubtless to the explosive being hard, it is not so easily introduced into a rough or irregular hole, while the tendency to jam probably leads to an undue application of force. It is important to point out that in such circumstances even a wooden rammer is no protection, for more than half the rammer accidents were caused with wooden tools.

The accident at Kirkee, India, was of another sort. Two officers of the 28th Pioneers had cut some gun-cotton slabs into strips and dried them all day in the sun. One of the officers then attempted to ram these strips into a bore hole with a copper rod, when the charge exploded. No undue force appears to have been used and there is little doubt that the accident was due to the abnormal sensitiveness of the gun-cotton at the elevated temperature existing. The exceptional sensitiveness of nitro-cotton when heated, and especially when in a fine state of division, has been illustrated by more than one accident, and the circumstances of these accidents are fully dealt with in Special Report No. XLIV, of December 9, 1882.

The gravest accident recorded is that of the explosion of 55 "tons" of blasting gelatine at Braamfontein, near Johannesburg, South Africa, on February 19, 1896, in consequence of a rail-

way collision. The explosion produced a crater about 300 feet long by 65 wide and 30 deep in soft ground. There was total destruction within a radius of about 330 yards, while from that distance to 660 yards all the buildings were shattered, and roofs were battered in up to about 1000 yards. The buildings were chiefly of corrugated iron and mud, and therefore not of a substantial character. Fragments of iron were picked up at over 3000 yards. Windows were broken generally up to about 2000 yards, and in one direction, where the ground sloped toward the site, many windows were broken up to 5000 yards and some beyond that distance. These effects agree closely with those produced by the explosion of an almost equal amount of gunpowder at Erith in 1864, and the comparison is especially valuable, as in the "Table of Distances" used by the Inspectors in fixing the sites of factories and magazines the distances for 50 "tons" were derived from the data of the Erith explosion.

In another accident in South Africa at the Langlaate mine, Transvaal, a young man was so overcome by the poisonous fumes from the dynamite blasts in one of the levels, which filled the shaft, that he fell from the cage in the shaft on which he was standing and was killed.

An accident which appeals particularly to naval officers occurred in the magazine of the Amiral Duperre, flagship of the French Mediterranean Squadron, May 14, 1896, due to the explosion of a 34-centimeter cartridge in the midst of a lot of loaded shells, which fortunately remained intact. The explosion was attributed to the overheating of a steam-pipe passing through the magazine.

An explosion of ammonium nitrate at Paddington, March 20, and of bleaching powder, have especial interest to the chemist. In the first case the manufacturer was making "laughing gas" and had placed 18 pounds of ammonium nitrate in an open enameled iron pot on the furnace to melt when shortly the contents exploded, broke the pan and the iron plate of the furnace and blew down the brickwork. Although this property of ammonium nitrate has long been known * and was considered when the application of the Bellite Co. was before them, this is the first instance of such an accidental explosion brought to the notice of the Inspectors.

* Proc. U. S. Nav. Inst. **19**, 92; 1892.

The explosion of bleaching powder, which was of a mild character, was reported to have occurred while a grocer was removing some bleaching powder from a barrel by means of an ordinary metal scoop. The bleaching powder, on examination, proved to be rather weak in chlorine, and contained nothing that semed to throw any light on the nature of the alleged explosion. This is the second time an alleged explosion due to this cause has been brought to the attention of Dr. Dupré. We notice that "Bloxam's Chemistry," 7 ed., 162, 1890, speaks of bleaching as evolving oxygen so as to shatter the bottles, and heating up so as to set fire to the casks in which it is stored.

As usual there is a record of the big blasts of the year, the first being that at Bonawe Granite Quarries, Argylshire, where 8 tons of gunpowder were fired. Six tons were placed in a chamber 125 feet from the surface and 65 feet from the face of the rock, and two tons in a second chamber 45 feet from the surface and 40 feet from the face of the rock, the distance between the two chambers being about 120 feet. The gunpowder used was especially manufactured for the purpose and contained 75 per cent. of saltpeter and was milled for three hours. The blast was estimated to have displaced 100,000 tons of rock.

The second blast took place at Dinorwic Quarries, Llanberis, and 3½ tons of Nobel's gelatine were exploded, but no data as to the effect could be obtained.

A "petroleum accident" of special naval interest is one which occurred on board the Cunarder S. S. Servia when a party of men were engaged in painting the inside of a water-ballast tank. The tank, which was 3 feet 6 inches deep, was divided into 16 compartments with 18 inch aperture between each. The furthest compartment was being painted at the time and it was necessary to crawl through 15 of the small apertures to reach it. The paint used was styled Patent Bitumastic Solution and one of the survivors testified that it took him four to five minutes to reach the compartments, ten minutes to do the painting, and four or five minutes to return, and that he could not stoop down any longer as it made him dazed and queer in his head. All the witnesses testified that the use of the solution in confined spaces made them drunk and delirious if they remained any length of time at work. This is a well known effect of the lighter petroleums, and it is not surprising that the solution

was found to consist of coal tar dissolved in crude coal tar oil, having a flashing point of 45° F. Abel, and containing so much volatile matter that one gallon spread over a large surface would render 48 cubic feet of air inflammable.

Notwithstanding this the workman went into this inner compartment, which was already partly covered with the freshly-laid solution and containing a partly filled bucket of it, with a lighted candle. Sometime having passed without hearing from him another workman went to his assistance and found the place on fire and the man burned and delirious. He was so delirious as to fight against coming out and it took an hour and a half with assistance to get him through the apertures and up the manhole, and he afterwards died in the hospital from the effects of the disaster.

This report contains a copy of the Explosives in Coal Mines Order of 1896, a list of "permitted explosives" for use in coal mines, and much tabular matter of importance.

We have through these Notes repeatedly called attention to the dangers which accompany the use of explosives in coal mines, the results of experiments made by various commissions in France, Prussia and England, and the invention of various explosive materials especially intended for use in fiery mines. The more recent steps taken looking toward an increase in security in the working of these mines were, first, the Order in Council of the English Home Office of December 16, 1896, which prohibited the use of any explosive, other than a "permitted explosive," after July 1, 1897, in all coal mines in which inflammable gas has been found within the previous six months, or in the roads of all coal mines which are not naturally wet throughout, and after January 1, 1898, the use of any explosive other than a "permitted explosive" is absolutely prohibited in every part of such mines. Further, the use even of "permitted explosives" is prohibited unless (*a*) every charge is placed in a properly drilled shot hole and has sufficient stemming, not in any case less than 9 inches; (*b*) the apparatus or method used for igniting the charge shall be incapable of igniting inflammable gas or coal dust; (*c*) every charge shall be fired by a competent person appointed in writing for this duty by the manager of the mine,

and not being a contractor for any work in the mine involving the use of explosives, nor a person paid by such contractor, nor a person whose wages depend on the amount of material to be gotten; (*d*) each explosive shall be used in the manner and subject to the conditions prescribed in the schedule of "permitted explosives." The use of explosives is prohibited in any main haulage road or main intake unless all workmen have been removed from the seam in which the shot is to be fired and all seams communicating with the shaft on the same level, except the men engaged in firing the shot, and such other persons, not exceeding 10 in number, as are necessarily engaged in attending to the ventilating furnaces, steam boilers, engines, machinery, winding apparatus, signals or horses, or in inspecting the mine.

The Schedule of Permitted Explosives accompanying this order consists of ammonite, Ardeer powder, bellite No. 1 and No. 3, carbonite, dahmenite A, electronite No. 2, kynite, roburite No. 3, and westfalite. The composition of each and the method in which they are to be put up is given with great precision and, what is of particular interest, the strength of the detonator to be used is specified for each explosive. In the case of each nitroglycerine explosive it is especially prohibited to fire it when in the frozen condition.

To secure more certain results a "Committee to inquire into the History of Explosives for Use in Coal Mines" was appointed by the Secretary of State, and through the courtesy of one of its members, Captain J. H. Thomson, R. A., we are in receipt of the "Report"* of this committee.

In its preliminary report of February 4, 1897, the committee considered the possibility of conducting its experiments in a coal mine, but concluded it would be fairer to use chambers where the conditions and tests could be made as uniform as possible; also the desirability of a small apparatus, but concluded that in view of the peculiar character of gas explosions no results would be trustworthy unless made in a chamber of considerable capacity and so arranged as to admit of experiments with air, gas and coal dust.

The committee then presented drawings of a suitable station to be erected at Woolwich and recommended an appropriation

* Eyre & Spottiswoode, London, 1897, 12 pp., 2 plates.

of $7500 for its erection and proof. The full report of October 6, 1897, contains a description with drawings of the apparatus, which consists of (1) a horizontal gallery of wrought-iron tubing used to test the liability of an explosive to ignite mixtures of coal-gas and air, and (2) a vertical tube to test the effect on coal dust suspended in air.

The gas gallery is fitted at its outer end with a device for holding a diaphragm of varnished paper or other suitable material, and at the opposite end it is closed by a disc of wrought iron having an opening in the center which is closed by the muzzle of a cannon when the latter is run up into position. The cannon is a very strong steel-lined wire-wound gun, having a bore of a diameter about that of the usual bore hole, and it is mounted on a small trolley running on rails. To prevent accidents from the bursting of the cannon a concrete wall has been provided on the side on which the observers stand. The gallery is fitted with seven safety valves to remove the strain when the gas explodes, and these serve also as sight holes by which to observe any flame which may issue. As mere observation of this kind is somewhat untrustworthy, a tuft of gun-cotton yarn is used as an additional test of ignition and is securely fastened in a position at the end of the tube, where only an explosion of the gas can ignite it. Alongside the gallery is a gasometer fitted with a gauge showing its contents, and a centrifugal blower, which are connected by pipes with both ends of the gallery so that a circulation of air and gas can be maintained through the gallery, gasometer and fan.

In preparing to fire a charge in this portion of the apparatus, the cannon is loaded and run up to the gas gallery, the gasometer filled with a measured quantity of gas at atmospheric pressure, and then, by opening the valves with which the connecting pipes are fitted and starting the fan, this gas is driven into the gallery and air removed at the same time from the opposite end. By keeping up this circulation for about one minute a uniform mixture of gas and air is obtained with very little leakage. The valves are then closed and the charge fired, the results being ascertained in the manner indicated above.

The coal dust apparatus consists of a vertical tube resting on a bed of concrete, in the center of which another cannon is placed vertically, being fixed in position by slats of wood. The tube

is fitted, near its base, with an opening in its side, closed by a strong door, through which the loading of the cannon is effected, and also, near the top, with an air and observation hole. Into this tube coal dust is blown by a fan similar to the one referred to above, the dust being fed into the pipe by means of a hopper.

In operating this apparatus air is driven along the pipe past the hopper, from which it carries with it the necessary supply of coal dust, and so soon as the operator considers that sufficient coal dust has been blown into the tube the charge is fired.

The testing station consists of two buildings, one of which contains the gas gallery and fittings. This building is completely open on one side, and the second building, placed on this side of the first, is fitted with an observation slit for the use of those attending the experiments, and is also fitted up as an office and storehouse.

The conditions prescribed for making the test are: (1) No explosive shall be submitted for testing until it has been admitted to the Home Office List of Authorized Explosives; (2) the test will be carried out for each explosive with the size of detonator recommended by the manufacturer or person submitting the explosive, and every shot will be fired by electricity; (3) all charges to be stemmed with nine inches of clay well rammed; (4) each shot to be fired in the case or wrapper in which it is proposed to be employed in actual use; (5) each shot to be fired into a highly explosive mixture of coal-gas and air, the gas being supplied from the Royal Arsenal gas works; (6) the charges of explosives to be fired will be determined as follows: (*a*) in the case of explosives intended to be fired by a detonator, and commonly called "high explosives," the charge will be taken as the equivalent of 2 oz. of dynamite No. 1, containing 75 per cent. of nitroglycerine, as determined by the enlargement obtained on firing the same in a lead cylinder tamped with loose sand; (*b*) in the case of gunpowder or any explosive not intended to be fired by a detonator, the charge will be taken as the equivalent of 6 ozs. of R. F. G. gunpowder, as determined by the enlargement obtained on firing the same in a lead cylinder tamped with loose sand and heavily weighted above with a mass of metal. (7) Each explosive to be subject to the following test: A number of shots shall be tried not exceeding 40. If in the first 20 no failure occurs, or in the first 30 only one failure, or in 40 only two failures,

it will be passed. A shot will be regarded as a failure if (*a*) it ignites the gaseous mixture, or (*b*) it leaves an appreciable amount of the charge unexploded. A shot may be repeated at the discretion of the officer in charge of the testing, if in his opinion there is reasonable ground to believe that a failure was due to any cause unconnected with the explosive. The proposed fee for an original test is £25, for a second trial £15, and for retesting from time to time, not to exceed 10 shots, £2. Since June 5, when the apparatus was first tried in the presence of members of the Institution of Mining Engineers, upwards of 700 shots have been fired and in no case has any accident occurred to the apparatus, although the cannon have been subjected to pressures estimated at over 100 tons to the square inch. Owing, however, to the high temperatures and pressures at the time of firing the erosion of the hardened steel lining tubes has been so great that it has been necessary to insert a fresh liner after about 200 shots.

The report discusses in detail the use of coal-gas versus fire damp, uniformity of gaseous mixtures, method of electric firing, method of determining an explosion, nature and quality of stemming, usefulness of firing unstemmed shots, size of charge, method of determining comparative power of explosives, size of detonator, delayed ignitions and other important matters.

It may not be amiss to inquire how the system of determining rejections was arrived at, for it is not apparent in what respect an explosive which fails once in the third ten rounds or twice in the second twenty is better than one that fails once in the first ten rounds or twice in the first twenty, or even better than one which fails twice in the first ten rounds. Of course the assumption probably is that a failure in the first ten or twenty rounds indicates a possibility of failure later on, but this is by no means certain to follow. In fact, the more often a given explosive is fired under similar conditions the more certain ought the firing to be with the increased experience, and it seems fairer after the fee is paid to give the applicant his full forty rounds.

The explosive art and science have suffered a severe loss in the death of Colonel Sir Vivian D. Majendie, R. A., K. C. B., Her Majesty's Chief Inspector of Explosives, which occurred suddenly, from heart failure, at Oxford, England, on April 24, 1898.

Sir Vivian Majendie was born in 1836 and entered the Royal

Artillery in 1854. He first saw active service in the Crimean War, in which he won the medal, with clasps, and the Turkish medal, and he achieved further distinction in the Indian mutiny. He became Captain of Artillery in 1861, Major in 1872, and Lieutenant Colonel in 1880, and Colonel (retired) in 1882. He was created Commander of Bath in 1880 and Knight Commander in 1895. He was for ten years on duty at the Woolwich Arsenal and in 1871 was attached to the Home Office as Inspector of Gunpowder Works under the Gunpowder and Nitroglycerine Acts. He was largely instrumental in securing the passage of the Explosive Act of 1875, as his testimony in the Minutes of Evidence and the official and statistical papers he filed, which appear in the Appendix, fill 162 of the large, closely printed pages of the Report of the Select Committee on Explosive Substances appointed by the House of Commons. It was fitting then that after having had so wide an experience and having displayed such thorough acquaintance with the subject, Major Majendie should, on the passage of the Act, have been appointed Chief Inspector.

While holding this office it fell to his lot to examine the bombs, infernal machines and explosives captured by the police, and though he ran serious personal risk, he was fearless in the performance of his duty. It is narrated that on one occasion he carried a rubber bag filled with nitroglycerine, which had been found in the house of a Fenian, in a cab to the laboratory at Woolwich, and that on the way he coolly informed the driver of the danger the latter would run if he did not drive carefully. When the cloak-room at Victoria Station was blown up he opened a clock-work infernal machine found there, though the mechanism was working at the time and the machine might have exploded at any moment.

While his services in the investigation of outrages brought him most conspicuously before the public, his most important service to his country was in so drawing and enforcing the regulations in explosive works as to render employment in these factories among the less hazardous of occupations for British workmen. One of his recent official duties was as a member of the Committee on the Testing of Explosives for Use in Coal Mines, through which it was sought to reduce the hazard in use as well as manufacture, and the week before his death he appeared to give evidence before the Select Committee of the

House of Commons to investigate the danger of low-flash oils. His influence has extended far beyond the confines of his country. For his successful efforts to ameliorate the condition of man he deserves to rank with Davy, Jenner, Francis, Lister and Florence Nightingale. His monument is the twenty-two Annual and fifty Special Reports which bear his signature as Her Majesty's Chief Inspector of Explosives.

His efficiency and tactfulness as an official is testified to by the trade journal, "Arms and Explosives," **6,** 126; 1898, which says: "The daily newspapers say nothing of the single-minded thoroughness with which he carried on the daily routine of his work at the Home Office, dealing only, as they do, with the more sensational incidents of his career, when, for instance, at considerable risk to himself, he opened an infernal machine, which, for all he knew, might go off at any moment.

"To those in the explosive trade, however, his ceaseless activity in the duties of inspection, the courtesy and fair-mindedness with which he carried out the stringent provisions of a highly complicated Act, will always remain among the keenest recollections of the past. Sir Vivian Majendie was the very best tpye of Government official, for he at all times recognized that trade interests must be considered even when departmental authority gave him the best excuse for disregarding such requirements. In no case, however, was the efficiency of his work allowed to suffer, whatever personal sympathies might suggest. He became Chief Inspector of Explosives when the Act first came into existence, and he has continued in office ever since, and year by year his annual reports have shown a steady improvement in the conditions of what was originally a dangerous industry. The precautions which have been elaborated under his care are now such that the death-rate by accident in the entire trade is little more than eight a year, a proportion which will compare most favorably with the ordinary mechanical industries of the country. To judge by experience, one would say that Sir Vivian Majendie was never happier than when carrying on his work, for the indefatigable industry with which he replied to all correspondence, and held himself personally available wherever his presence would be advantageous, was a lesson such as many younger men could with advantage take to heart. Whenever he was approached with a view to the modification of such rules and regu-

lations as seemed to bear with unnecessary hardness upon some section of the trade, he was always ready to receive representations upon the subject, and, wherever possible, he promptly introduced an Order in Council for remedying the ills which had grown up under changing conditions of trade."

The notice alludes to his fondness for photography and his love for children, which was heartily reciprocated by them, and it is accompanied by an admirable portrait which depicts the alert and ever-ready look which was the most prominent characteristic of the original.

The following specifications for smokeless powders for cannon, prescribed by the Ordnance Department, U. S. Army, were issued by the War Department May 12, 1898:

Manufacture.—The manufacture must be open to inspection in all its stages by an inspector designated by the Chief of Ordnance, U. S. A., for the purpose.

Composition.—The powder must be substantially of the composition designated by the Ordnance Department as N N (12.0-25), which consists of one part of nitroglycerine and three parts of nitro-cellulose, containing 12 per cent. of nitrogen, and at least one-third of the nitro-cellulose must be of the soluble variety. A small amount of a suitable neutralizer may be added to insure chemical stability. No departure from the above-stated composition will be made without the approval of the inspector. The ingredients must be of excellent quality and the degree of nitration, as determined by the Lunge nitrometer, close to that prescribed.

Granulation.—The granulation may be of any well-known form, suitable for the use intended, that may be desired by the manufacturer, but must be subject to the approval of the inspector.

Lots.—The powder will be prepared for inspection and delivery in lots, each containing, if practicable, about 10,000 pounds if for a piece of caliber below 8 inches, and about 25,000 pounds if for a piece of 8-inch caliber or over. The exact amount of each lot will be fixed by the inspector after consultation with the contractor. Each lot must be blended to the satisfaction of the inspector.

Inspection.—The inspector will select during manufacture such samples of the ingredients as he may desire to examine. After the lot is blended he will select samples for inspection and proof.

Proof.—Each lot, to be acceptable, must give, with about the charge and under the conditions stated in the following table for the particular case, a muzzle velocity as great as, and a mean pressure not greater than, therein stated, and the chamber pressure must not exceed in any round the pressure stated by more than 2000 pounds.

Piece.	Charge.	Projectile.	Chamber pressure.	Muzzle velocity.
		lbs.	*lbs. per sq. in.*	*f. s.*
.30-caliber rifle, service	37 grs.	.....	38,000	2,000
3.6-inch mortar, service	6 ozs.	20	17,000	700
3.2-inch field gun*	15.25 ozs.	16.5	32,000	1,450
3.2-inch field gun†	16.6 ozs.	16.5	26,000	1,450
7-inch siege mortar, service	38 ozs.	125	17,000	775
8-inch B. L. rifle, service	70 lbs.	300	35,000	2,250
10-inch B. L. rifle, service	140 lbs.	575	35,000	2,250
12-inch B. L. rifle, service	250 lbs.	1,000	35,000	2,250
12-inch mortar, steel, service	50 lbs.	800	33,000	1,300

* With projectile having band 1¾ inches from base.
† With projectile having band ⅝ inch from base.
NOTE.—For pieces within a bracket the same powder is used.

Stability.—The powder must not be unduly subject to accidental ignition or explosion, or to deterioration under exposure to climatic conditions or in storage. Also, it must withstand successfully the following test: Heated to a temperature of 150° to 155° F., it must not produce any discoloration of potassium iodide starch paper, partly moistened with dilute glycerin, in less than 20 minutes. Chemical and ballistic tests made by the Ordnance Department according to its standard methods will be regarded as standard for the purposes of these specifications.

Delivery and Payment.—The powder will be delivered packed in simple wooden boxes or in packages furnished by the Ordnance Department, at the option of the Chief of Ordnance. All samples selected by the inspector will be delivered at such places as he may designate by the contractor. Payment for each lot will be made on acceptance and delivery, but samples representing rejected lots will not be paid for.

The "Annual Report of the Chief of Ordnance War Department for 1897"* is made up of a summary by the chief of the operations of the department, and twenty-nine separate, illustrated

* Washington, Gov't Printing Offic, 1897, 300 pp., 19 plates.

reports from the commanding officers of the various arsenals and the inspectors of powder and ordnance, which contain much detailed information and record the results of many interesting experiments.

Referring to small-arm ammunition and smokeless powder, General Flagler says the .30-caliber ball ammunition with strengthened case and the blank cartridge with paper bullet have given satisfactory results in service. The expectation that the fired .30-caliber shells turned in from service could be used for reloading has not been realized, as the metal of the case after being fired with smokeless powder becomes brittle. The cause of this in the present shell, which is made of brass (70 copper and 30 zinc), has been traced to the action of the mercury in the primer composition on the metal of the case and particularly on the zinc. The loaded cartridges, when new, can be safely kept as no deterioration occurs until after firing, when the primer is burned and the gases liberated within the case. At present it is expected that a serviceable reloading cartridge will be produced by reducing the amount of mercuric fulminate in the primer, in conjunction, possibly, with the use of an alloy for the cases containing a less percentage of zinc.

Another form of reloading case was proposed by Lieutenant Dunn, the feature of the design being a sliding base sealed with a rubber ring. It is in some respects similar to the Morse cartridge, but differs from it in essential particulars. It offers the advantage of using an alloy, such as so-called gilding metal (93 copper, 7 zinc), which is but little susceptible to the brittleness referred to, but which when made into the present form of solid head case does not possess sufficient strength to resist the high pressures attained in the .30-caliber rifle. The tests thus far made on this case for endurance are favorable and they are now being subjected to storage tests.

Investigations have been made upon the utility of tinning the case of the .30-caliber cartridge for smokeless powder, and the conclusions reached are that under normal conditions of storage brass cartridges do not need protection against erosive action from either black or smokeless powder, but when moisture is present in excess or when the powder has suffered material decomposition, a slight protection, serving at least to defer such action, is afforded by the tin coating, and this, taken in connec-

tion with the neat and distinctive appearance given to the finished product, justifies the use of tinning.

It has been observed that there is a marked tendency to rise and fall of velocity of smokeless powder ammunition depending upon the temperature of the cartridge when fired in the arm, and experiments have been made with the .30-caliber rifle cartridges to determine the changes in velocity for temperatures ranging from $-40°$ to $+130°$ F. at intervals of 10 degrees. For this purpose each lot of cartridges was brought to the desired temperature by exposure for twenty-four hours in a chamber having the required temperature and fired. From the data derived from these experiments and from repeated "heat" and "cold" tests previously made in the laboratory of Frankford Arsenal the average results deduced for service ammunition are as follows: The velocity for the .30-caliber rifle varies about 120 feet per second between the limits of temperature given. Taking the standard of 2000 feet per second for a temperature of 70° F. at proof, it diminishes for each 10° fall of temperature by decrements varying form 8 to 3 feet per second, the loss at $-40°$ being about 43 f. s.; and for each 10° rise of temperature it increases from the standard by increments of from 10 to 12 feet per second, the gain at 130° being about 65 f. s.

The Peyton powder at present manufactured by the California Powder Works and the Dupont Company, is now used for the .30-caliber service ammunition, and is satisfactory. In addition to the contracts made with these companies for the supply of powder during the current year, a contract has been made with the Laflin & Rand Powder Company for a quantity to be delivered subject to test, and this company is now experimenting to produce a .30-caliber powder along the lines of its W-A powders. In previous tests this powder has shown excellent ballistic results, but produced undue erosion of the bore of the rifle. It has been found that the endurance of a rifle firing the Peyton powder will readily exceed 5000 rounds, and the specifications for the .30-caliber powder now include a test for erosion, under which "the erosion of the bore, after firing 5000 rounds, must not materially exceed that exhibited by the rifle barrel No. 21,244, which has been fired 5000 rounds and will be retained at Frankford Arsenal as a present standard of reference." It is now also provided that each invoice lot of powder must be thoroughly blended by the manufacturer.

The exposure of service cartridges in shallow open trays to the weather for one year is now systematically pursued and constitutes a most severe test of their keeping qualities. Lots of cartridges made from different invoices of powder are taken from the factory and exposed in this manner, and a portion of each lot is tested at the end of each four months. The tests made with the service powders during the past year confirm those previously reported. Although the loss of velocity from the exposed cartridges was sometimes considerable, the stability of the powder was not decreased, and when heated to 130° F. for twenty-four hours, to ascertain if the powder had been permanently injured, its ballistic properties were restored to nearly the same magnitude as those possessed by the original powder heated to the same extent. The interior of the cases was not injured by contact with the powder during exposure and the primers of the cartridges remained unaffected. Two additional lots of the .30-caliber cartridges charged with Peyton powder and sent to Whipple Barracks, Arizona, for storage, in April, 1895, were returned to Frankford Arsenal after storage periods of twenty-one and twenty-four months. When fired, these gave nearly the same results as those which had been stored for periods of three, six and nine months; in none of which was there any material change from the original quality of the ammunition.

Referring to larger grained powder, General Flagler says it appears conclusive that when nitroglycerine is used under service conditions there appears to be no objection to its employment in powder, but that, on the other hand, there are decided advantages on the score of high ballistics and economy. These conclusions are drawn from general information and from the results of experiments with various smokeless powder compositions, described in his last annual report as being in progress. All these, except those involving long storage, were completed during the year, and the results but confirm the conclusions derived from the earlier and principal portion of the experimental series.

To investigate more fully powders composed essentially of nitro-cellulose and nitroglycerine three compositions of the type designated "N N" (nitro-cellulose, nitroglycerine) were selected as follows:

N N (13-10); nitro-cellulose yielding 13 per cent. of nitrogen, the powder containing 10 per cent. of nitroglycerine.

N N (12-25); nitro-cellulose yielding 12 per cent. of nitrogen, the powder containing 25 per cent. of nitroglycerine.

N N (11-40); nitro-cellulose yielding 11 per cent. of nitrogen, the powder containing 40 per cent. of nitroglycerine.

These compositions were regarded as including the practicable variations within the type, and as producing only allowable erosion and heating effects. As granulation is a mechanical process it was thought best to interest private manufacturers in the solution of this problem, and contracts were therefore awarded to different firms under the above specifications but leaving the manufacturer to choose his form of granulation, it being expected thus to obtain comparisons of the behavior of these different compositions in the several forms of granulation, such as strips, thin squares, tubes and multiperforated grains. Other types than the "N N" are also to be tested and orders have been laid for sample lots of Peyton and "W-A" composition for the 8-inch B. L. R. and of Roltweil composition for the 10-inch B. L. R.

On August 2, 1898, the Navy Department issued the following specifications for U. S. Navy smokeless powder, which is an ether-alcohol colloid of soluble nitro-cellulose, with or without metallic nitrates. The specifications for the ingredients and the solvent are as follows:

I.—Ingredients.

1. *Soluble nitro-cellulose, known as pyro-cellulose.*—It shall contain 12.5 ± 0.1 per cent. of nitrogen, at least 98 per cent. of soluble nitro-cellulose, and less than 1 per cent. of ash, cellulose, and other substances insoluble in acetone. It shall give a heat test at 65.5° C. of at least eighteen minutes, and shall be pulped very fine, all passing a sieve of No. 16 mesh.

2. *Barium nitrate.*—To be entirely free from moisture, ground very fine, all passing a sieve of No. 50 mesh, containing at least 99 per cent. $Ba(NO_3)_2$, less than 0.2 per cent. of chlorides (calculated as $BaCl_2$), and not more than 0.1 per cent. of insoluble material.

3. *Graphite.*—To be chemically pure, containing not more than a trace of silicates or compounds of sulphur.

4. *Potassium nitrate, c.p.*—To be ground very fine and thoroughly dry, of the quality employed in the manufacture of highest grade black powder.

II.—Solvent.

1. *Ethyl ether.*—Concentrated, containing no impurities except small amounts of water and ethyl alcohol; clear and colorless; of characteristic pure odor; neutral reaction; specific gravity at 20° C. between 0.717 and 0.723; leaving less than 0.002 per cent. residue after evaporation at 100° C.

2. *Ethyl alcohol.*—92.3 per cent. absolute (by weight). To be clear and colorless; of characteristic pure odor; neutral reaction; leaving less than 0.006 per cent. residue after evaporation at 100° C.

3. *Quantity.*—In case the mixed solvent, composed of 64 parts by weight of ether and 36 parts of alcohol, is supplied by the Department, the weight allowed will be equal to 1.1 that of the finished powder less that of the contained metallic nitrates, and in case alcohol only is furnished by the Department, the manufacturer making his own ether, the weight of alcohol allowed will be 1.4 times that of the finished powder less the contained nitrates.

III.—Method of Manufacture.

1. *Pyro-cellulose.*—No particular method of manufacture is prescribed, provided a material is obtained which conforms strictly to the above specifications. The following method has given satisfactory results at the torpedo station:

Cotton, free from oil and mechanical impurities and containing not over 7 per cent. of moisture, is dipped, in portions of 1 pound each, in 19 pounds of mixed acid contained in an earthenware crock. This mixed acid is composed of about 57 per cent. H_2SO_4, 28.2 per cent. HNO_3, and not more than 0.2 per cent. N_2O_4. The initial temperature of the acid at the time of dipping is about 25° C. The cotton is completely immersed in the acid and held down by an earthenware disk. The crock with its contents is then placed in a trough of warm water, of which the temperature is

about 36° C. At the end of thirty minutes' digestion, the crock is removed from the trough, and the contents turned over with a fork. The crock is replaced in the trough and the digestion is continued for thirty minutes longer. The excess of acid is then removed in a centrifugal wringer and the pyro-cellulose is immersed in a large volume of running water. It is then transferred to a washing centrifugal wringer, where it is washed for fifteen minutes by a stream of water from a hose, being turned over at the end of half this period in order to facilitate the washing. The pyro-cellulose is next pulped at atmospheric temperature in a dilute solution of sodium carbonate, until the requisite fineness is obtained, and is then heated at 70° F. for three hours in a 0.05 per cent. solution of sodium carbonate and washed for three minutes in a centrifugal wringer.

2. *Smokeless powder.*—The finished pyro-cellulose, before the colloiding, is to be dried or dehydrated until it contains less than 1.5 per cent. of water. The dry ingredients of the powder, consisting either of pyro-cellulose alone, or of pyro-cellulose and a prescribed amount of barium nitrate and potassium nitrate in the proportion of four parts of the former to one of the latter, are to be colloided by means of a solvent composed of 64 parts by weight of ethyl ether and 36 parts of ethyl alcohol, the weight of solvent being at least equal to that of the dry pyro-cellulose. The mixing is to be continued until the material is a perfectly homogeneous mass, free from uncolloided particles. No change in the composition of the solvent or in the ratio of solvent to dry ingredients is to be allowed, unless the product is a perfect colloid of standard toughness. This colloid is to be pressed into powder through dies of such form and dimensions as may be prescribed by the Department for the different calibers. In case the powder is in the form of a ribbon, the drying is to take place between wooden strips, or sheets of blotting paper, or in such other manner as will prevent warping or sufficient distortion to render difficult the loading of the powder into the cartridge case. In the manufacture of small-arm powder, the colloid, in the form of a sheet, is to be cut into flat grains, nearly square in outline, of which the length or width is to be about 2 mm. and the thickness about 0.28 mm. After not less than twenty-four hours' drying, these grains are to be graphited. The finished powder for all calibers shall have been dried at 38° to 43° C. until a sample, heated at

100° C., loses less than 3 per cent. of its weight before an odor of decomposition is noted.

IV.—Finished Powder.

1. *Physical properties.*—(*a*) The finished powder is to be a perfectly uniform colloid, free from lumps and uncolloided material.

(*b*) The strips or grains are to be of the standard smoothness and toughness.

(*c*) The dimensions of the strips or grains are to be in accordance with the specifications of the Department.

(*d*) The strips or grains shall be of such uniform density that, in a given weight of charge for any caliber, the variation from a mean value in the number of strips or grains shall not exceed 1 per cent.

2. *Chemical properties.*—(*a*) *Composition.*—The finished powder shall contain not more than 3 per cent. of substances volatile at 100° C., and shall show, by analysis, that its ingredients possessed the requisite properties and were mixed in the prescribed proportions.

(*b*) *Stability test.*—The finished powder should give a stability or heat test equal to that of similar powder made at the torpedo station, which withstands a temperature of 100° C. for a period of at least ten minutes without discoloring the standard potassium iodide and starch paper.

This test may be made by use of the standard apparatus, with the water bath replaced by a bath of glycerine. The value given above is to be regarded as tentative only, as experiments thus far made have included samples of powder made at the torpedo station only.

(*c*) *Ballistic properties.*—The finished powder shall give the required velocity within a maximum pressure, the values to be prescribed by the Department for the various calibers.

Bids were opened on September 3 for 1,000,000 pounds of powder made according to these specifications and they reached to 79½ cents per pound.

Under the title "An American Smokeless Powder," *Sci. Am. Sup.* **46,** 18,946-18,947; Aug. 27, 1898, Frederick H. McGahie says, among other statements: "An American powder, the Maxim-Schüpphaus, offers a superior and scientific solution of

the problem whose correctness has been proved by trials and tests extending over the last four years. It is the standard of the United States army, and, after futile attempts to produce a satisfactory powder of their own, the United States navy has lately adopted it.

"The formula employed during its development was 90 parts mixed gun-cotton, 10 parts nitroglycerine, 1 part urea, the nitroglycerine being added principally to insure good ignition. But the M. S. powder is not a definite one. The formula can be varied widely so as to meet all beliefs of ordnance experts."

It will be interesting to compare these statements with the foregoing specifications and reports.

In the "Report of the Chief of the Bureau of Ordnance to the Secretary of the Navy for 1897," * Commodore O'Neil says of the work at the Naval Torpedo Station, considerable quantities of gun-cotton and smokeless powder have been manufactured during the past year and researches have been made resulting in the development of a special variety of nitro-cellulose, soluble in ether-alcohol, forming a colloid of extreme toughness, that burns progressively in a very regular manner and which may be converted directly into smokeless powder, decomposing wholly into gaseous products, and possessing a high ballistic efficiency. With the new form of colloid velocities of about 2500 f. s. have been obtained with 5 and 6-inch R. F. guns with pressures of about 16 tons per square inch, and velocities of 2800 f. s. are readily obtainable with the 1-pounder R. F. within the pressure limit of 15 tons per square inch. The powder is quite smokeless.

The problem of the development of smokeless powder may be considered solved, and as the capacity of the factory at the torpedo station is insufficient, orders for 100,000 pounds each have been laid with a firm on the Atlantic coast and one on the Pacific coast for smokeless powder made in conformity with the Bureau's formula. The deliveries have been made in part and the powder will be issued to vessels in commission so soon as it can be procured and prepared.

The Bureau is of the opinion that for national and economic reasons the Department should own and operate a smokeless-powder factory, at which it could produce a part of the powder

* Washington, Government Printing Office, 1897, pph. 66 pages.

required for the naval service, and an item ($93,727) has been inserted in the annual estimates for this purpose. The property known as Bellevue Magazine, on the Potomac just below Washington, would be an excellent site, and it is conveniently reached by water and by railroad, and is but two hours' distance from the Naval Proving Ground. The present price of smokeless powder procured by purchase is very high, and the Bureau believes it can produce it in large quantities at a greatly reduced price. The success of the Bureau with its gun factory encourages it to believe that it could do equally well in the manufacture of other munitions of war.

The reserve supply of powder on hand is limited, and no effort has been made to accumulate a large quantity, owing to the uncertain state of the development of powders and because it was believed that the brown powders now in use must soon give way to the improved smokeless powders. A point has now been reached when a satisfactory powder of the latter class has been developed, which is believed to possess excellent keeping qualities and to be superior in every way to the brown powders; and the Bureau recommends that a quantity sufficient to refill all the vessels of the Navy be procured, and with this in view has inserted an item ($1,000,000) in the annual estimates to begin its accumulation.

Commander Conden, Inspector of Ordnance in charge of the Naval Proving Ground, says the manufacture of a satisfactory smokeless powder has been established, and samples have been tested for all calibers and the powder is now being supplied for all guns up to and including the 6-inch. Powder for the 13-inch B. L. R. was tested in February, 1896, and samples still on hand (September 10, 1897) in the magazine have undergone no change so far as can be judged. The results in all cases are higher velocities with lower maximum pressures than with brown powder, and, coupled with the absence of obscuring smoke, it may be said that the offensive power of every vessel in the Navy will be very sensibly increased by the introduction of these powders. We may congratulate ourselves that we were not led by the apparent difficulties of the situation to adopt the very dangerous nitroglycerine powders that have been very generally adopted in other navies. Our own experience with such powders showed their very dangerous lack of keeping qualities.

Tests have been made of the Gathmann projectile designed to carry very large charges of wet gun-cotton. The essential feature of the projectile is the attempt to use a very thin wall, giving great space for the charge, by equalizing the pressure on the inner and outer surface of the shell. This is done by making the caliber of the projectile considerably less than that of the gun except at the head, where the rifling band is placed and allows free play of the powder pressure upon the outer walls, while a movable piston in the rear transmits the same pressure to the interior walls. A 13-inch tube bored out to 12 inches, fitted with breech-mechanism, chambered to suit the projectiles and rifled for part of the way, and projectiles with walls ¼-inch thick were used, but though the projectiles were filled with inert material they broke up under 6 tons pressure. On increasing the thickness of projectile wall to ½-inch they stood a pressure of 8 tons and reached a velocity of 1686 f. s. Such a shell loaded with 307 pounds of wet gun-cotton was tested in the gun June 9 with the result that the gun was destroyed, pieces being thrown to more than a mile distance and in every direction.

In connection with these tests experiments were made to determine the effect of the superficial explosion of large charges. Two steel plates, 13 feet by 7 feet by ⅝ inch, were fixed vertically on the beach 50 feet apart, being parallel to one another and securely braced. The plates were slightly curved and the *curved* (?) sides were toward each other. A Gathmann projectile, containing about 340 pounds of wet gun-cotton, was placed on the beach between the plates, 35 feet from one and 15 feet from the other, and fired by electricity. The explosion was of a high order and locally severe, very small fragments of the shell being found in the vicinity, but the plates remained uninjured, not even being displaced, and no effect of any kind was produced on them. A second Gathmann projectile of the same size, loaded with 220.25 pounds of shell powder, was fired in the same position between the plates with practically the same results except that there were rather larger holes made in the ground. A third Gathmann projectile, containing 307 pounds of wet gun-cotton, was hung against the face of an armor plate standing vertically against a target structure. The plate was 7.5 by 16 feet, 16.5 to 9.5 inches thick and weighed 28 tons, and it had received two test shots for acceptance before this experiment. The shell was

supported on wooden blocks against the middle portion of the plate, so that the whole length of the shell bore horizontally against the plate, and fired by electricity. An explosion of the first order occurred, but the damage to the plate was nil. The face of the plate was fused and burned over a space of 5 feet 10 inches by 8 inches to a maximum depth of 5/8 inch. The side of the shell next to the armor plate was flattened out and burned into a ragged sheet 5 feet 7 inches by 8 inches. A chicken tied on the ground immediately in the rear of the plate was uninjured; one placed in a cofferdam 50 feet from and in front of the plate was uninjured; one placed in a cofferdam 25 feet from and in front of the plate was killed; one placed unprotected on the ground 43 feet from and in front of the plate was scorched and struck by flying fragments. The abstractor understands that these charges were fired with primers of dry gun-cotton. It is to be regretted that the dimensions of the craters formed were not recorded, as these furnish useful criteria.

Tests of randite for comminution were made by filling a 4-inch wrought-steel common shell with 3 pounds 12.5 ounces of the explosive and firing by electricity in a shed fitted up for the purpose. The explosion was very violent and the shed badly wrecked. In a second test a 4-inch A. P. projectile was charged with 6.7 ounces and exploded with a service single-wire electric primer. The explosion was violent and prompt, and the projectile was broken into many fragments. The explosive seemed very mild and inert when burned in the open air—in fact, difficult to burn—and also very insensitive to shock.

Joveite has been tested at various times during the year as a charge for armor-piercing projectiles with satisfactory results. Some failures were recorded in the early trials, detailed in the last annual report, due to an insufficient igniting charge of black powder in the fuse. Three 6-inch A. P. projectiles were fired through a half-inch steel plate with excellent bursts and break-ups. Two 6-inch A. P. were loaded with joveite on November 24, kept in the magazine until May 6, and then tested with most excellent results, using high pressures, a velocity over 2000 f. s. and a steel plate one and a half inches thick. A 6-inch A. P. projectile was fired with a velocity of 1860 f. s. at a cofferdam protected by a 4-inch nickel-steel face-hardened plate at a point where the cellulose was 4 feet 8 inches thick. The projectile

passed through and exploded about 3 feet in the rear of the cofferdam. A similarly loaded 6-inch A. P. projectile was fired at a cofferdam having a 5.5-inch nickel-steel face-hardened plate on the outside. The shell broke up after passing through the cofferdam, but did not explode. The fuse was recovered and it evidently had failed to ignite the joveite, some of which was in the fuse stock. Portions of the charge of joveite were also found scattered about. A 10-inch A. P. projectile, loaded with 8.75 pounds of joveite, was fired through a 4-inch steel plate on August 28. The explosion took place immediately in the rear of the plate, as was determined by marks of fragments of the projectile in the structure supporting the plate. The results were observed from the launch in the river. The break-up of the projectile was excellent, many pieces scattering along the shore and the surface of the river for a quarter of a mile. The largest fragment found weighed not more than three pounds.

Since the above report was written a 10-inch Carpenter, capped, A. P. projectile loaded with 8.25 pounds of joveite and fused, having a total weight of 523 pounds, was fired with a velocity of 1860 f. s. against a side armor plate of the Kentucky, the impact being at a point where the plate was 14.5 inches thick. The projectile completely perforated the plate and as the fuse functioned properly the projectile burst into a large number of pieces just beyond the plate. There was some slight color from unburned joveite. Ten pieces of the projectile were recovered from the sand having a total weight of 198 pounds, the largest fragment weighing 100 pounds. It was evident from the appearance of the timbers that the explosion took place close to the face of the plate and on the rear side, as no portions of the shell were found on the front side.

In another round a 10-inch semi-A. P. Midvale shell, containing 28 pounds of joveite, of a total weight of 511 pounds and unfused, was fired with 230 pounds of powder against the same plate at a point where it was 16 inches thick. The striking velocity was 1925 f. s. The shell penetrated the plate to a depth of about 12 inches and burst with great force. The plate was thrown down and broken through at all previous cracks. Only one recognizable piece of the shell was recovered, and this was a portion of the base plug which had been sheered off longitudinally and from

which a portion of the screw threads had been entirely removed. This breaking up of the base plug seems evidence of a severe explosion, as in no other case has a base plug been found thus broken.

It may seem proper in this connection to call attention to the article on "High Explosives and Modern War Vessels,"* *Engineer*, December 24, 1897, and *Jour. Roy. U. S. Inst.*, **42**, 475-477; 1898, and to Sir Charles Dilke's† article, republished elsewhere in these Proceedings.

Through the courtesy of Mr. Hudson Maxim, we are in receipt of the following pamphlets containing his work: "A New System of Throwing High Explosives from Ordnance," which is a lecture delivered before the Royal United Service Institution, and reprinted April 15, 1898, from its Journal, in which he describes his invention through which he seeks to provide an aerial torpedo projectile which shall carry a maximum of high explosive with a minimum weight of metal, and at the same time be of such constitution, strength and integrity as to enable it to withstand the shock of acceleration and the pressure of the propelling gunpowder charge, without danger of disruption or distortion of the torpedo or its premature explosion. The torpedo is to be thrown from a light-walled large caliber gun by a charge of Maxim-Schüpphaus torpedo powder, giving a pressure of 10,000 pounds, and to be exploded by a Maxim-Alger fuse. No armor penetration is claimed for the projectile, but the large mass of explosive to be thrown is expected to work havoc.

The second pamphlet is a separate from the *Cosmopolitan Magazine* **25**, 327; July, 1898. It is entitled, "The Engineering Problem of Aerial Torpedoes." The third pamphlet, entitled "Aerial Torpedoes," is reprinted from *Cassier's Magazine* for 1898, and each of these treat of the same subject and traverse much of the same ground as the first, though they are variants.

The fourth pamphlet, reprinted from *Engineering*, June 10, 1898, is entitled the "Maxim-Schüpphaus Smokeless Powder," and deals with the method of producing the multiperforated grain and the manner in which it burns. All these articles are well illustrated and are worthy of examination.

* Proc. U. S. Nav. Inst. **24**, 367-370; 1898.
† Proc. U. S. Nav. Inst. **23**, 740-741; 1897.

We are again indebted to the courtesy of Lieut. W. R. Quinan, superintendent, for the following detailed account of the circumstances attending a recent explosion at the California Powder Works, Pinole, California:

"I have to report that one of our nitroglycerine houses (the new one) was blown up about 1.30 A. M. on the 27th of July, 1898. There were two distinct explosions a few seconds apart. A number of our men went to the scene, manned the fire hose and put out several small fires that started on the site. As soon as it was light enough a large gang of men was put to work to clean up the debris. While they were engaged in this work a second explosion took place (about 5.30 A. M.), which killed four and wounded ten of our men.

The circumstances attending the explosion so far as known were as follows: The house has been in operation since early in June. It was in good order and worked almost perfectly. Since we have been using the Rodeo water we have been bothered somewhat with scums in the waste tanks and in the filters. This is chiefly chalk precipitated from the water by the soda we use in washing. It gives trouble by clogging the filters and making slums in the wash tanks. It holds a little nitroglycerine, and this is so difficult to separate that lately we concluded to throw it overboard rather than let it accumulate. To this end our men have colleced it in wash tubs which were periodically taken down to the wharf and dumped. Having some repairs to make to the acid cooling department, which could be best done while running the old nitroglycerine house, we concluded to shut down the new house for a few days and to take advantage of the chance to put in a settling tank for the chalk and to put in a new piece of apparatus, viz., a water-lift, to lessen the labor of the men in handling the slums. The house was accordingly shut down on the 26th (after the work for that day was finished) and cleaned up. The last man of the nitroglycerine gang left the house 3.30 P. M. Attended by Mr. Bermingham, the head carpenter and head lead-burner, I visited the house about that hour to give directions about the changes in the house.

The situation in the house was as follows: All the apparatus, including mixers, separators, drowning tank, wash tanks and waste tanks had been cleaned and washed out. The last charge had been filtered and sent down the flume and the switch broken.

The chalk slums had been collected and put in two wash tubs and mixed with sawdust. (This is done for safety in handling on the cars.) The tubs were placed on a brick pavement in the basement of the building. The only other explosive matter in the building was a little nitroglycerine mixed with acid that always drains back into the blow-cask (a steel vessel to pump with compressed air the waste acid from this building up to the acid cooling house), and a little nitroglycerine held by capillarity in the salt filters on the lower floor of the building. The small amount of unwashed nitroglycerine which the men could not collect and wash in time was sent down to the outside waste tanks about 100 feet away. The house was cleaned up with special care as we wished to put carpenters to work at once in the building. Four of them began operation before four o'clock and worked all the rest of the afternoon.

The amount of nitroglycerine in the blow-cask was unusually small. The foreman, Mr. Graves, an hour after the last charge had been pumped up, gave the cask a second blowing with air. We have used blow-casks over 11 years. We have never had any accident with them except once when a cask was left lying in the hot sun for several days. The basement of this house was cool. The situation was such that it would be a stretch of imagination to suppose a spontaneous explosion either in the cask or in the tubs which contained nothing more harmful than a crude low grade dynamite. However, we have been saved any speculation of this kind. There is indisputable evidence that the explosion was not spontaneous.

Just before the disastrous explosion about 5.30 A. M. a piece of *freshly* burnt fuse about five feet long was found in the shattered lumber which the men were hauling away from the building. Four men testified before the coroner's inquest to the finding of this fuse, which was handed to Mr. Bermingham a few seconds before the disastrous explosion. The conclusion is that some miscreant stole into the house in the dead of night and blew up the tubs. These exploded the blow-cask, which was about eight feet away and above the level of the tubs.

A close examination of the wreck seemed to show that the tubs exploded first; also that the blow-cask was moved from its seat before it went off. There was no crater or disturbance of the ground immediately under its usual seat. The serious dam-

age done was confined to the lower part of the house. The wash tank floor was partly thrown down, two of the three wash tanks toppled over, the roof fell and the filters were covered with miscellaneous debris. The second disastrous explosion came from the filters while the men were working directly over them. The amount of nitroglycerine here was very small. We regain the nitroglycerine by dissolving the salt, so that we can estimate the quantity quite closely. There were not more than ten pounds at the outside and it was scattered through about 400 pounds of wet salt.

Our men in cleaning up the debris acted for the best. They believed there was no danger in working over this and they thought it prudent to clean the place up before the sun came with the heat of day to cause possible trouble. The simplest theory to account for the disaster is that when the blow-cask exploded a little acid and dirt was thrown into the filters and this set up a chemical action which culminated in explosion about four hours afterwards. The stuff being brought to the critical point may have been set off by a slight jar, but in regard to this it is useless to speculate. Under ordinary conditions I do not think a fulminate cap would have exploded it.

There is one more point to be noted. The tubs (ordinary wooden wash tubs) were old dynamite carriers and held a lot of nitroglycerine absorbed into the wood—about 12 or 15 pounds each, taking the gain in weight as a criterion. It was this that did most of the damage to the building and not the mixture of scum and sawdust. The amount of nitroglycerine in the latter probably did not exceed five pounds and there was such a large admixture of sawdust it was barely explosive."

"Explosive Materials." * The phenomena and theories of explosion and the classification, constitution, and preparation of explosives, by John P. Wisser. This book is issued as No. 70 of Van Nostrand's Science Series, but it must be remembered by bibliographers that it is a distinct work, as the original contained a translation of Berthelot's Lecture on Explosive Materials, by Dr. Marcus Benjamin, a translation of Braun's Historical Sketch of Gunpowder, by Lieut. John P. Wisser, and a Bibliography of

* New York, D. Van Nostrand Company, 1898, sm. 8vo., 160 pp.

Works on Explosives, by Mr. W. H. Farrington. The first edition having become exhausted, it became necessary, in order to keep the series complete, to issue a new edition, but as, in the fifteen years which have elapsed since the appearance of the first edition, many changes have taken place in the views held regarding the phenomena of explosions and many new explosives have been produced, particularly the important class of smokeless powders which have attracted attention, it was deemed best to have the book rewritten, and this work was wisely put into the hands of Captain Wisser. The subject-matter of the present volume is based on the original essay of Berthelot, but the theories set forth by him are modified by those that have been formulated by Cooke, Abel, Threlfall and Mendeléef, and Captain Wisser has blended these into a most lucid presentation of the subject as now most generally accepted. In addition to this, Captain Wisser has given sufficiently clear descriptions of a large number of explosives and of the processes of manufacture of the more commonly used ones to satisfy the needs of the average reader or military man. In fact, it is surprising that he has been able to put so much information into a "pocket volume." It is to be regretted that the publishers have not given the work a setting equal to its merit and that many of the pages should be distinctly offensive in their make-up. The book ends with an ample index.

"Manual of Military Field Engineering,"* for the use of officers and troops of the line, by William D. Beach, is the second edition of a work by Captain Beach in the revision of which he has collaborated with Lieut. Root and Lieut. Slavens, and which has been approved by the Secretary of War for special study by officers of the army subject to examination for promotion. Upwards of twenty pages of the book and three plates are devoted to the use of explosives in military demolitions. The usefulness of the book would be improved by a table of contents.

"Scientific American Army and Coast Defense Supplement"† is a collection of articles on gun, projectile, armor and explosives which have appeared from time to time in the Scientific

* Kansas City, Hudson-Kimberly Publishing Co., 8vo, 1897. 282 pp., 60 plts.

† New York, Munn & Co., 1898, lg. 8vo, 64 pp., 110 Ill.

American and Scientific American Supplement, and which were believed to be of popular interest during the war. The articles are of varying merit and accuracy, but the cuts are attractive.

"Lectures on Explosives," * by Willoughby Walke, is the second revised and enlarged edition of a course of lectures prepared in 1891 especially as a manual and guide in the laboratory of the U. S. Artillery School at Fort Monroe, and which has now been officially adopted for the examination of officers of artillery for promotion in the corps. The work is well arranged and published in good form.

"Notes on Cordite" † is the title of a trade circular issued by Kynoch, Limited, of Birmingham, England, which contains excellent cuts of the Lion Works at Wilton, the cordite and nitroglycerine works at Arklow, Ireland, machinery for blending cordite, cartridges of cordite for different calibers and other cuts. The pamphlet treats of the relations of smokeless powder to gunpowder, describes in general terms the manufacture of smokeless powder, dwells upon the question of the sensitiveness of smokeless powders to climatic changes, and states that cordite has been proved, both in India and Canada, to have maintained the same velocities and pressures as at the test ranges at home. Referring to the objection that the heat it develops tends to erode the barrel of a rifle, it is claimed that an ordinary .303 magazine rifle will fire 10,000 rounds of cordite without becoming unserviceable. Also it is stated that the conditions under which cordite is accepted by the British Government do not allow an extreme variation between the maximum and minimum velocities of the projectile greater than 40 or 50 feet per second in a speed of 2300 feet per second, and that in practice the mean deviation usually does not exceed 10 feet. Tables are given for the charges, muzzle velocities and steel plate penetration with cordite for each of the calibers from .303 rifle up to 6-inch Q. F., and comparison is made with gunpowder for five of these calibers, but no mention is made of pressures.

* New York, John Wiley & Sons, 1897, 8vo, 435 pp.
† Wilton, Birmingham, Kynoch, Limited, no date, 4to, 22 pp., 13 Ill.

Arms and Explosives **6,** 40; 1897, reviews "Des poudres pyroxylin pour fusils de chasse." * Quelques mots de résponse au resumé de la conférence donnée le 18 Janvier 1897 par M. Jules Polain. By Henri Quersin.

The *Revue d. Artil.* **51,** 608; 1898, announces "Treatise on Service Explosives" † (official) and "Regulations for Magazines, Ammunition Stores, Laboratories," etc.‡ (official); also in **52,** 196; 1898, "La plastoménite,"§ by General Wille.

* Brussels, Paul Lacombles.
† London, Eyre & Spottiswoode, 1895, 8vo, 126 pp.
‡ London, Eyre & Spottiswoode, 1894, 8vo, 190 pp.
§ Berlin, Eisenschneider.

SPECIAL BULLETIN.
U. S. FLAGSHIP NEW YORK.

ABSTRACT OF THE LOG OF THE CHRISTOBAL COLON FROM APRIL 8TH TO JULY 3RD, 1898.

(The Sea-Day from Noon to Noon was used.)

Date. April.	Course.	Distance.	NOON POSITION. Latitude.	Longitude.	SPEED.	WIND. Direction.	Force.	Revolutions.	Steam Pressr.	No. of Boilers.	Coal consu'd.	REMARKS.
8—9	S. 47° W.	230.0	34° 02′ N.	3° 31′ W.	12.0-13.0	E.S.E.&N.E.	3-6	60-62	120-140	7	81 tons.	Left Cadiz in company with Maria Teresa (Flag) 4.37 p. m. April 8th, 1898. Roll 10° to 20°, period 6.5 s.
9—10	S. 45° W.	284.0	30° 40′ 11″ N.	7° 31′ 00″ W.	10.0-12.5	N.N.E.	5-6	50-65	110-140	6-7	83 tons.	Celebrated High Mass at 10. Read Art. of War. Published G. C. M. Order.
10—11	S. 41° W.	235.0	28° 00′ 51″ N.	10° 17′ 00″ W.	6.0-12.5	N.N.E. to N.	4-7	40-60	110-130	4-6	66 tons.	Sighted Tenerif ahead. Exchanged signals by International code. Pilot board with sealed package for Captain.
11—12	S. 34° W.	310.0	23° 54′ 13″ N.	13° 25′ 45″ W.	12.0-12.5	N.E. to N.	3-5	60-63	130-140	7	85 tons.	No. 2 gun failed to turn; found the fault and remedied it. After part exercised Small arms.
12—13	S. 36° W.	279.0	20° 11′ 07″ N.	16° 17′ 10″ W.	10.5-12.5	N.E.	4	54-60	120-130	6-7	73 tons.	The after part exercised at Carbines in the afternoon.
13—14	.....	....	.....	.....	9.0-11.0	N.E.	4-5	54-56	120-130	6	.....	9.40 a. m. flagship anchored. At 10.08 anchored in 8 fms.: Pajaros Id., N. 20° W.; Fort, N. 70° E.; West point, N. 12° E.; in St. Vincent, Cape de Verde I's.
14—15	At anchor in St. Vincent, Porto Grande.											At 8 p. m. went into sea watches; extinguished all unnecessary light from outside view. Doubled the guards and redoubled vigilance, both inside and outside the ship in compliance with orders. Distilling. Two steamers came in and anchored. Kept Battery (secondary) ready for action.
16—17	in 19m water	do	and 45 fms. on port chain.									Coaling from lighters.
17—18		do										Coaling from lighters. Shifted anchorage to following bearings: Pajaros Is., N. 17° W.; Fort, N. 73° E. The Spanish mail steamer San Francisco entered during forenoon watch.
18—19		do										Finished coaling in the 4 to 8 (evening) watch. Cleaning ship. The Almirante Oquendo and Viscaya came in and anchored during the forenoon watch.
19—20		do										10 to 10.30 a. m. exercised clear ship for action without arms, followed by great gun drill until 11.
20—21		do										The Commodore and Captains met on board at 1.00 p. m. in obedience to signal, they left at 5.00. Exercised 12 c-m and 15 c-m guns of battery from 10 to 11 a. m.
21—22		do										Exercised great guns from 10 to 11.15 a. m.
22—23		do										After part exercised carbines from 2 to 4 p. m.
23—24		do										Lighter with 30 tons coal came alongside during first watch; commenced coaling at 4 and finished 8.00 a. m. Another lighter with 78 tons came alongside during forenoon watch, from which took 25 tons by noon.
24—25		do										Afternoon watch Commanding Officer Teresa came on board—commenced coaling 1.30 p. m.—4 to 8 watch another coal lighter with 50 tons arrived; finished previous one; at end of watch about 25 tons left in lighter. 8 to 12 p. m., 54 tons more came. Finished coaling during forenoon watch.
25 26		do										Lighters came alongside during p. m. with coal and a 75mm gun for the destroyer Furor, together with 8 bbls. Olive Oil and 2 cases mineral oil (44 tons loose coal and 45 in bags).
26—27		do										P. M. 89 tons coal, artillery stores and supplies for the Furor, and wines and provisions came alongside. Coaling. Rec'd 4 boxes exercise torpedo-heads and a 75-mm gun for Furor.
27—28		do										Receiving coal loose, 21.5 tons, and in bags, 20.0 tons, and store for the Furor. Sent to the Furor 16 cases of stores. Finished coaling during forenoon watch.
28—29	S. 86° W.	33.0	16° 52′ 40″ N.	19° 20′ 30″ W.	10.0—*Stopped and Manœuvred*	N.E.	2-4	49	120	5	11 tons.	Left Porto Grande, a. m. April 29, in company with Infanta Maria Teresa (flagship), Oquendo, Viscaya, and destroyers Furor, Terror and Pluton.
29—30	S. 86° W.	90.0	16° 45′ 52″ N.	21° 17′ 30″ W.	2.0-13.0	N.E.	3-5	45-50	90-120	5	32 tons.	Torpedo-boats in tow. Trouble with st'b'd air pump. 60 revs. with port engine. Exchanged signals.
30—1	S. 86° W.	180.0	16° 29′ 20″ N.	24° 16′ 30″ W.	5.5—9.0	N.E.	3-4	40-58	110-120	5	33 tons.	Steaming with port engine, helm 10° port. Towing Furor. Reported st'b'd engine ready noon; watch by sig. Held divine service.

SPECIAL BULLETIN. U. S. FLAGSHIP NEW YORK. } ABSTRACT OF THE LOG OF THE CHRISTOBAL COLON FROM APRIL 8TH TO JULY 3RD, 1898.—*Cont.*

(The Sea-Day from Noon to Noon was used.)

Date. May.	Course.	Distance.	NOON POSITION. Latitude.	Longitude.	SPEED.	WIND. Direction.	Force.	Revolutions.	Steam Pressr.	No. of Boilers.	Coal consu'd.	REMARKS.
1—2	S. 84° W.	152.0	16° 13′ 58″ N.	26° 54′ 27″ W.	4.0—8.0	N.E.toE.N.E.	3-4	40	100-120	5	29 tons.	Teresa towing Pluton; Oquendo towing Terror; we towing Furor. Tried elec. primers. 11 a. m. slowed down to allow the Oquendo to resecure her tow.
2—3	S. 85° W.	182.0	16° 01′ 00″ N.	29° 58″ 30″ W.	6.0—7.0	E.N.E.	3	40-42	100-120	5	28 tons.	Repaired Capstan damaged at St. Vincent. Terror signalled to fire. Signal made to exercise frequently at General Quarters at unexpected times day and night without previous notice being given.
3—4	S. 83° W.	175.0	15° 43′ 30″ N.	32° 51′ 15″ W.	6.0—7.3	E. to E.N.E.	1-2	40	100-120	5	29 tons.	Terror had firing drill in the afternoon. Slowed to renew tow p. m., then proceeded.
4—5	S. 84° W.	170.0	15° 30′ 00″ N.	35° 42′ 15″ W.	6.0—7.0	E.	3	40	100-110	5	28 tons.	Screw of torpedo-boat fouled by flotsam at 9.05 a. m.; stopped and cleared it; started ahead at 10 a. m.
5—6	S. 84° W.	170.0	15° 16′ 16″ N.	38° 34′ 45″ W.	6.5—7.0	E.	3	40	100	5	30 tons.	Towing Furor. Forenoon flagship signalled "We are steering by hand."
6—7	S. 85° W.	170.0	14° 59′ 55″ N.	41° 24′ 15″ W.	7.0—8.0	E. to N.E.	2-4	40-44	98-105	5	30 tons.	Artillerists given theoretical instruction. Slowed from 10.30 to 11.15 a. m. to allow flagship to renew tow.
7—8	S. 84° W.	180.0	14° 44′ 20″ N.	44° 27′ 30″ W.	7.0—8.0	N.E. to E.	4	44-45	90-100	5	34 tons.	Received permission to try search-lights. Slowed 7 a. m. to renew towline of torpedo-boat which had parted.
8—9	S. 84° W.	170.0	14° 32′ 25″ N.	47° 18′ 15″ W.	8.0	E.	4-6	44-45	90-100	5	32 tons.	At 8.50 slowed, and at 9.00 a. m. stopped both engines for repairs and cast off tow. Started ahead 10.50 a. m.
9-10	S. 87° W.	160.0	14° 19′ 45″ N.	49° 56′ 45″ W.	6.0—9.0	N.E. to E.	4	41-53	95-100	5-6	32 tons.	Slowed down afternoon watch to repair starboard engine, and at 2.25 p. m. to allow Oquendo to repair tow. Stopped during 1st watch to let other vessels catch up.
10-11	S. 88° W.	218.0	14° 13′ 20″ N.	53° 38′ 10″ W.	8.0-10.0	E. to N.	3-6	47-50	90-100	6-5	46 tons.	6.45 p. m. cleared ship for action and sent all hands to their stations to remain there all night. 9.00 a. m. sighted vessel to port; went General Quarters until made her out to be Terror. She communicated with Flagship.
11-12	N. 81° W.	90.0	14° 29′ 00″ N.	55° 08′ 00″ W.	3.7—7.0	E.	3-4	24-33	100-110	4-8	22 tons.	4—8 Martinique on starboard hand. Beat to General Quarters and kept all hands at their stations. Stopped from 5.15 to 6.15 a. m. Flagship cast off Terror from tow. 7.30 a. m. sent 3rd cutter to Flagship. 7.10 Diamond Rock 4m.
12-13	S. 73° W.	281.0	13° 18′ 41″ N.	59° 47′ 28″ W.	10.0-13.0	S.W.toE.S.E.	0-4	55-68	100-105	6-8	60 tons.	12.20 p. m. lost sight of Martinique. At 5.45 a. m. secured and went to breakfast. 9.25 a. m. Flagship signalled:—"The vessels, on entering port, will be as clean as possible, and the crews will shift."
13-14	S. 70° W. S. 40° W.	208.0	12° 02′ 40″ N.	62° 43′ 00″ W.	8.0-12.0	S.E.	4-6	33-55	75-110	6	43 tons.	6.30 a. m. sighted Curacao, and at 8.00 it bore N. Forenoon watch the Flagship and Viscaya entered the harbor; this vessel, the Oquendo and the destroyers remaining outside.

Forenoon watch the Flagship and Viscaya entered the harbor; this vessel, the Oquendo and the destroyers remaining outside.

SPECIAL BULLETIN.
U. S. FLAGSHIP NEW YORK.

ABSTRACT OF THE LOG OF THE CHRISTOBAL COLON FROM APRIL 8TH TO JULY 3RD, 1898.—*Cont.*

(The Sea-Day from Noon to Noon was used.)

Date. May.	Course.	Distance.	NOON POSITION. Latitude.	Longitude.	SPEED.	WIND. Direction.	Force.	Revolutions.	Steam Pressr.	No. of Boilers.	Coal consu'd.	REMARKS.
14-15	*Off S. Coast of Curacao.*					S.E.—E.S.E.	4-6	*As Ordered*	70-90	2-5	23 tons.	At midnight the Santa Ana light bore N. Forenoon watch lowered 3rd and 4th cutters, and took Terror in tow. Moving engines at times to maintain position near Oquendo.
15-16	N. 48° W.	110.0	13° 28′ 00″ N.	64° 28′ 15″ W.	4.0—9.0	S.E.	3-6	23-45	100-110	5	26 tons.	P. M. coal Terror with cutters, which was finished at 5.30 p. m., having supplied her with 34½ tons. 5.15 Pluton came out of harbor with Teresa and Viscaya. Stopped and waited for Viscaya to make repairs to engine.
16-17	N. 48° W.	189.0	15° 36′ 31″ N.	66° 55′ 30″ W.	5.0—9.0	S.E.—E.S.E.	4-5	45	110	5	40 tons.	2.30 p. m. Flagship made signal:—"If you want a cow send boat." Answered:—"Many thanks, do not require any." At 7.30 p. m. went to General Quarters and kept crew at stations all night.
17-18	N. 42° W.	158.0	17° 32′ 00″ N.	68° 50′ 00″ W.	5.0—8.5	S.E.	4-3	28-34	105-110	4-5	33 tons.	Morning watch Flagship signalled:—"Oquendo change station with Viscaya." "Admiral intends making port of Santiago." "Be prepared for action tonight in case the enemy appears."
18-19					5.0-12.5	S.E.-N.N.E.	0-6					At 4.30 a. m. sighted island of Cuba ahead. Entered Santiago harbor on the morning of the 19th of May. At 8.20 anchored in 10m. water with 15 fathoms on starboard chain; bottom, mud. Cheered by Mercedes on coming in.
19-24	Santiago de Cuba, W. I.—[No record in log between these two dates; 24-25 being designated as the first day of "Singladura" (Day's run, or, "Current Events").]											
24-25	do	do	Shifted anchorage in the harbor of Santiago de Cuba on the morning of May 25th, 1898; draft fo'd 7m.50, aft 6m.45. At 6 engines ready and, with the pilot on board, weighed anchor, which was soon catted; cast to port. Under direction of the Commanding Officer passed between Ratones Cay and Julias P't and proceeded in the channel to a point to the N'd of Smith Cay and at mouth of Gaspar Bay, where we anchored at 7.00 a. m. in 20m. of water with the port anchor, mud bottom. At this time the vessels of the enemy were discovered off the mouth of the harbor; Morro made signal to begin firing; orders were given to man the main battery; but in a short time it was seen that it would be obstructed as an English steamer was about to enter the harbor. Got out stream cable from port quarter to the south beach of the bay (Gaspar) and veered and hauled chain until another was gotten from starboard to the opposite shore and then secured both. Head S. 57° W. with 75 fathoms of chain outside and moored on the following bearings:—Gorda P't, N. 19° W.; Cuarentina P't, Smith Cay, S. 48° E.; and Morro P't, S. 5° E. 8.40 a. m. to noon got out a second mooring to starboard and made fast until we had secured the buoy on the same quarter which had been placed as a mark. Got out steel hawser on starboard side, and sent crew to breakfast.								
25-26	Anchored with springs on cables, in Gaspar Bay.		Lowered 2nd steam launch which took sailing launch in tow to bring back liberty men and provisions at 3.30 p. m. During 4 to 8 watch the small-arms were gotten ready and the rapid-fire battery loaded. At 6.00 a. m. secured small-arms, unloaded rapid-fire battery, and then crew went to breakfast. 8 a. m. to Noon lighter came alongside which commenced unloading at once. Squally.								
26-27	Anchored in Gaspar Bay.		At 3.00 p. m. hove in port chain to 30 fathoms, heaving in on port stream chain and veering on the starboard. Finished coaling 4 to 8 p. m. watch. 8 to 12 p. m. semaphore signalled two suspicious vessels in sight. Mid to 4 a. m. steam launch returned towing water boat. 8 a. m. to noon veered cables to bring stern to the beach in such wise that the 15.2 c-m. gun No. 2 would cover the mouth of harbor with its fire. The watch-tower signalled 3 of the enemy's vessels in sight accompanied by torpedo-boats or smaller vessels.								
27-28	do	do	Noon to 4 p. m. anchored and moored in Gaspar Bay, 75 fathoms on port chain, and two moorings to port and one to starboard; secured to the beach. Artillery (main battery) ready for action. 4 coal lighters came alongside, commenced discharging at once. 5.30 p. m. semaphore signalled:—"The enemy has disappeared." Coaling and taking in water.								
28-29	do	do	Finished coaling at 4.00 p. m. Sent Ensign La Ciera to Morro for information regarding enemy's vessels and the buoys said to have been planted by them; he reported as follows by semaphore:—1st, Black buoy S. W. ¼° S., distance difficult to determine but estimated 4 miles; another buoy is being looked for. 2nd, The enemy disappears to the S. W. ¼° S.; no white buoy is seen. 3rd, Seven vessels in sight, the Brooklyn and Iowa distinguishable; two vessels are approaching the buoy. The semaphore, in its turn, announced:—"5 vessels in sight with small vessels or torpedo-boats." 4 to 8 p. m. lighted a red light and showed in on starboard side in order to indicate position of our bow to the rest of the squadron. At 7.30 a. m. commenced firing at 14,000ms., the enemy's squadron coming from the E'd and steaming in column past the mouth of the harbor. There were recognised the Brooklyn, Indiana, Iowa (flag), Minneapolis, Texas, and a merchant vessel. Manned all the starboard battery and loaded with heavy ammunition.								

SPECIAL BULLETIN
U. S. FLAGSHIP NEW YORK.

ABSTRACT OF THE LOG OF THE CHRISTOBAL COLON FROM APRIL 8TH TO JULY 3RD, 1898.—*Cont.*

(The Sea-Day from Noon to Noon was used.)

Date May.	Course.	Distance.	REMARKS.
29-30	do	do	Noon to 4 p. m. various North American vessels in sight, among which could be distinguished the Iowa, Indiana, Brooklyn and Texas type and some merchantmen. 4 to Mid American vessels continue to pass by mouth of harbor with their search-lights thrown on the coast. At 4.00 a. m. the two destroyers returned, having been cruising at the mouth of the harbor and reporting enemy's vessels from W. to S. E. from point, i. e.: B., T., Ind., Ia., a yacht and merchantmen. The Ensign of the Pluton, on passing this vessel on way to the Flagship, reported having been within about 4 miles of the enemy's vessels. At 11.00 sent an officer and 2 Quartermasters to the semaphore on duty; they reported:—"Enemy's Squadron in sight," by semaphore; and by flag signals announced the arrival of a man-of-war with two masts, with three military tops on each, and two smoke-stacks.
30-31	do	do	Noon to 4 p. m. paid the crew; at end of watch 4 enemy's vessels in sight which appeared to be the B., Min., Tex., and an armed merchant vessel. At sunset two enemy's vessels below horizon. During Mid watch the destroyers and vedettes cruised several times to the mouth of the harbor, and when one of the vedettes returned it signalled the letter K with the Colomb signals and then disappeared behind Cay Smith. Morning watch sent ten men to coal torpedo-boats; semaphore signalled:—"Enemy's Squadron in sight" and at end of watch "Two shots to the W'd."
May. June.	Position.		
31—1	Anchored in Gasnar Bay and at Ratones Key.		At 1.15 sent 10 men to coal Pluton. At 2.15 the Iowa passed W. to E. at short distance firing at us; beat to General Quarters—2.15 to 5.00 p. m. Bombarded by the enemy's Squadron from 3 p. m. At General Quarters for action. As soon as the enemy's Squadron opened fire and was standing across the mouth of the harbor from the western point and heading to the Eastward at high speed, and consisting of the Iowa (flag), Massachusetts, Brooklyn, Amazonas, Texas, Marblehead, City of Rome (apparently), and four auxiliary cruisers; we commenced firing with the port 15 cm. battery, which continued with rapidity, and correcting the excitement conveniently in order to diminish tendency to waste ammunition. Then commenced with the 12 cm. guns and continued the firing during the time it took them to cross the mouth of the harbor. The Amazonas and large transatlantic steamer having stopped, we then concentrated all our fire on them both. In a short time the other battleships returned, and then the action continued on both sides, but our shot falling short on account of the enemy keeping at too great a distance. A battleship, apparently the Brooklyn, and the transatlantic liner remained in front, and repeating our fire, a tug was seen to approach the latter and astern of her the other battleships were nearing the former. Observed that they retired, convoying them and another steamer at a greater distance, also appearing to have suffered damage, to the S'd without answering our fire. At 3.15 H. E., the Comd't Gen'l of the Squadron, came on board in the Teresa's steam launch, and soon afterward ceased firing on account of the silence and withdrawal of the enemy. We were accompanied in our offensive attack by the Socapa battery and that of Morro. 62 rounds were fired from the 15 cm. battery and 14 from the 12 cm. The firing-pins of three of the 12 cm. guns and of six of the 15 cm. were damaged, but they were at once repaired. An enemy's shell exploded near the stern, making dents in the side and cracking some bowls in the round-house. When the ships retired it was in disorder and, in our judgment, confirmed the fact that two of them required convoying by the Brooklyn as already mentioned. Kept the whole port battery loaded, and at 5.00 p. m. resumed sea watches. At 9.30 p. m. six of the enemy's vessels passed from E. to W. across the mouth of the harbor, returning at 11.30 the other way. Semaphore signalled:—"The Flagship has seen a vessel to the E'd, near the coast, and that upon the vedettes going out two shots were heard, and that the enemy's Squadron would pass close by the mouth of the harbor." The Flagship asked the distance; replied that report would be made upon return of vedette. 4 to 8 a. m. the enemy's Squadron in sight, passing the mouth of the harbor, first from E. to W., afterward from W. to E., at a great distance and beyond range of our guns; they appear to have been re-enforced by several vessels. At 9.00 a. m. sent men to coal the Furor. At 10.20 a. m., by order of the Comd't General of the Squadron, cast off the springs. At 10.35 a. m. got underway, and under direction of the Commanding Officer cast to starboard and under slow speed passed between Punto Gorda and the bow of the Oquendo. Directed our course into the inner harbor until 11.50 a. m., at which time we came to an anchor in 9.5m. of water, with 15 fathoms on port chain; bearings at anchor Ratones Cay, S. 36° W.; Yarey Pier, N. 11° W.; and Compadres Rock, S. 30° E.
1—2	At anchor in harbor of Santiago de Cuba.		During afternoon watch unloaded the 12 cm. guns and the 154 mm. battery. 4 to 8 p. m. unable to unload 4, 6, 8, and 10 of the 15 cm. battery. Semaphore made signal that the enemy's Squadron was in sight, and at 5.00:—"The enemy is approaching"; the Flagship transmitted the signal:—"The enemy is directing his course to the mouth of the harbor."
2—3			Afternoon watch semaphore signalled the enemy's Squadron in sight—3.30 p. m. coal lighter came to starboard side; commenced coaling. Stopped coaling at 9. p. m. At 3.25 a. m., hearing a lively firing of guns at the mouth of the harbor, called and armed the crew, got the battery ready, and supplied a case of ammunition for each rapid-fire gun. 4 to 8 a. m., the firing continued at short intervals at the mouth of the harbor. Lighted two boilers and shifted closer to Ratones Cay with 15 fathoms on port chain and ready to slip at a moment's notice. Lowered 2nd steam launch and anchored all the boats which were in the water close to the coal lighter. At 7.00 a. m. received information from the Flagship by signal:—"Merchant vessel which had entered the mouth of the harbor was sunk while passing Nispero Bay; she was struck by two torpedoes, one from the Pluton and the other an observation mine; we captured one officer and seven North American sailors." 8 a. m. to noon got out kedge with 60 fathoms on it, and secured on the following bearings:—Ratones Cay, S. 27° W.; Compadres Rock, S. 78° E.; and Julias Lookout, S. 12° E. Signals were made to us concerning the movements of the enemy's vessels.

SPECIAL BULLETIN
U. S. FLAGSHIP NEW YORK.

ABSTRACT OF THE LOG OF THE CHRISTOBAL COLON FROM APRIL 8TH TO JULY 3RD, 1898.—*Cont.*
(The Sea-Day from Noon to Noon was used.)

Date. June.	Position.	REMARKS.
3—4	At anchor in harbor of Santiago de Cuba.	At 1.00 p. m. H. E., the General Second in Command left the ship; lowered his flag. Flagship made signal:—"Light fires under all boilers and have steam by 6.00," soon afterward:—"Amended, steam on boilers by 10 o'clock." 4 to 8 p. m. semaphore signalled that the enemy's Squadron was approaching. The Flagship made signal:—"Do not let fires go down but have the boilers ready for steam in 4 hours." At nightfall some shots were heard in the direction of the Morro. At 10.30 p. m. cannon-firing was heard at regular intervals and two discharges at the mouth of the harbor. Watering ship.
4—5	do	4 to 8 p. m. watering ship. The semaphore made signal:—"The enemy opens fire." After supper armed the crew without loading the small-arms. At 3.30 a. m. steam launch brought coal lighter to port side; finished coaling during 4 to 8 a. m. watch and commenced taking in water from launch. At 10.00 a. m. held divine service. At end of watch signal still hoisted on semaphore:—"Enemy's Squadron in sight."
5—6	do	7.45 a. m. the enemy opened fire. 8 a. m. to noon cast loose and loaded the rapid-fire pieces of both batteries. The enemy's fire lasted until 10.35, being answered by the shore batteries; at this time the semaphore made signal that the enemy was withdrawing to the E'd. At 11.15 firing was again heard to the E'd, which continued to end of watch, though far distant. At 10.30 the Chief of Staff arrived and, by his orders manned the rapid-fire guns of the Mercedes, which had been installed at the mouth of the harbor; sent two petty officers, four artillery men from the turrets, and thirty men from the turrets, all in command of Lieutenant Grisi (or Gusi) and Ensign Servert. This force returned on board by order of the Admiral of the Squadron, but upon arrival was held in readiness for immediate departure. Sent several men to the hospital.
6—7	do	Merid. to 4 p. m. sent the 34 men to the Mercedes. Received information of the death of Com'd'r E. Costa, Executive of the Mercedes, and of 5 men; Ensigns M. Dore and A. Molines, and 12 men were wounded. Unloaded the charges from both batteries. At 5.20 p. m. semaphore made signal that the enemy were firing upon the shore; several distant shots were heard. At 9.00 p. m. asked permission to test search-lights, which worked satisfactorily. Taking in water from launch. Secured the Marymak's boat, repaired it and supplied it with a new rudder.
7—8	do	Taking in water. At 7.00 p. m. four search-lights of the enemy were seen illuminating the shore.
8—9	do	During the afternoon watch launched two torpedoes from the starboard stern tube to test their speed. 7.00 p. m. enemy's search-lights illuminating the shore which continued all night. Held divine service at 10.
9-10	do	The North American ships continued lighting the coast with their projectors, especially the mouth of the harbor. The Viscaya made signal at 9.30 p. m. that the ships were about 3 miles from shore. At 1.00 a. m. same informed the Flagship that the enemy's ships were firing rockets and burning blue lights. 10.30 semaphore signalled that the enemy had opened fire. At end of watch the enemy retired.
10-11	do	The enemy's Squadron kept the shore constantly illuminated with their projectors during the night, especially the mouth of the harbor. Watchword, "Gonzalo"; password, "Gibara"; countersign, "Granetazo"; which signals of recognition were reserved for the large ships; for the torpedo-boats, tugs, etc., the night letter for the 11th to 12th insts. is "N."
11-12	do	Nothing of importance. Watchword, "Ibo"; password, "Ibega"; countersign, "Intento."
12-13	do	Enemy's search-lights illum'ing shore and harbor all night. Watchword, "Munerio"; password, "Mueritas"; countersign, "Monio." Night letter 12" to 18", "M"—for to-night, "A."
13-14	do	At 11.15 p. m. heard seven shots which seemed to have been fired from the Socapa. Enemy's search-lights trained on shore and entrance to port all night.
14-15	do	Received on board. 5 tons of rice; other provisions alongside. Enemy's search-lights trained on shore and entrance to port all night.
15-16	do	At 11.15 p. m. heard five shots fired, one, apparently, from the Socapa, and the others by the enemy. At 5.20 a. m. the enemy's Squadron opened a heavy fire, aiming at the shore batteries; several projectiles fell inside the harbor. At 6.30 the enemy's fire slacked, and our batteries continued answering them until 6.35.
16-17	do	Enemy's search-lights on port entrance all night. Sent 10 armed men to the Mercedes. At 5.00 a. m. the enemy opened fire to the W'd, on Cabrera P't, which lasted until 5.45 a. m.; according to signal received this was done by the Texas, a yacht and two steamers. 9 to 10.30 a. m. exercised in landing artillery. Sent launch for water.
17-18	do	Enemy's search-lights trained on mouth of harbor all night.
18-19	do	4 to 8 p. m. boat returned from making an examination of the Merrymak. At 10.50 p. m. about 5 shots were heard, evidently fired by the Socapa and Morro at an enemy's ship which had approached within a short distance of the entrance. At 7.00 a. m. heard some cannon shots which subsequently were supposed to be an American yacht saluting the Squadron. Watchword, "Salvador"; password, "Soria"; countersign, "Sobre." At 10.00 held divine service, and read some of the Articles of War.
19-20	do	Enemy's search-light trained on shore and mouth of harbor all night. At noon an explosion occurred at the wharf; cause unknown. Watchword, "Nicario"; password, "Nada"; countersign, "Norise."
20-21	do	Enemy's search-lights trained on shore and mouth of harbor all night. At 7.30 a. m. the General Second in Command* came on board in the Mercedes' boat; hoisted his flag. At 11.15 a. m. the Mercedes came up into the inner harbor and anchored.

* A flag officer in the Spanish service is usually spoken of as "General." The officer here mentioned was a "Capitan de Navio" of the First Class, equivalent to our "Commodore."

SPECIAL BULLETIN
U. S. FLAGSHIP NEW YORK.

ABSTRACT OF THE LOG OF THE CHRISTOBAL COLON FROM APRIL 8TH TO JULY 3RD, 1898.—*Cont.*
(The Sea-Day from Noon to Noon was used.)

Date. June.	Position.	REMARKS.
21-22	At anchor in harbor of Santiago de Cuba.	At 10.45 p. m. shots were heard, apparently from the Vesuvius, which were answered by our batteries. At 8.05 a. m. shots were heard from the enemy's Squadron, which were replied to by our batteries; the enemy continued firing slowly until 11.30 a. m.
22-23		At 10.40 p. m. three shots were heard near the entrance, and also others further off. In obedience to signal disembarked with provisions and ammunition, in two launches, in command of Ensign Gossi and Sagrara. 8 a. m. to noon sent provisions on shore for the landed force. Launch with 30 tons of coal came alongside, which commenced discharging at once.
23-24	do	Requisition for provisions for the company on shore was made upon the Captain of the Port. 4 to 8 p. m. Lieut. Emilio Butron was lent for duty in the Estrella battery. At sunset the enemy's search-light began to illuminate the shore. Ensign Eurique de la Cierva returned from duty in the Estrella. At 8 p. m. armed and kept all hands at their stations. Finished coaling at 8.00 a. m. Sent steam launch with fresh provisions and stores to the company on shore. Sent 50 fixed charges on shore for the pieces with the landed company. At end of morning watch semaphore signalled that the enemy had opened fire on the beach to the eastward.
24-25	do	Semaphore flying signal:—"The enemy is firing at the shore to the E'd." At 1.00 p. m. some cannon shots were heard to the E'd. Sent three days provisions to the company landed at La Cruz. Flagship signalled:—"Guardship Oquendo, doctor Teresa, chaplain Teresa." At 4.40 a. m. heard cannon firing to E'd, and the semaphore signalled that the enemy had opened fire on the beach in that direction. Sent provisions to the detachment at the "Dos Caminos del Cobre," and by the steam launch to that of Los Cruces. At 10.30 semaphore signalled:—"Enemy is firing on the beach to the E'd." Lieutenant Milre left for Estrella.
25-26	do	At 4.00 p. m. several cannon shots were heard, and semaphore signalled that the enemy was firing on the shore to the E'd; shortly afterward and in the next watch two discharges of musketry were heard. At sunset two picket-boats and a destroyer left for outside. At midnight four shots were heard, two of them from the Morro; soon after Viscaya signalled Teresa that the Vesuvius had thrown two shells, the Morro replying with the other two. Enemy's search-lights trained on entrance all night. At 10.00 a. m. the steam launch took provisions to the detachment at Dos Cruces, returning immediately. Held divine service.
26-27	do	4 to 8 p. m. sent cartridges and five chests of Mauser ammunition to the detachment in command of 3rd officer. Got ready the artillery of the port battery. At 10.30 p. m. the Viscaya signalled to Teresa that the Vesuvius, a destroyer and a picket-boat were in front of the semaphore and about 3 miles distant. At 1.15 a. m. two discharges were heard at the Morro; the Viscaya reported that the Vesuvius had thrown three shells, to which the Morro replied. At 2.15 a. m. three shots were heard to eastward, which the Viscaya reported had been fired at Aguadores. At 5.00 a. m. sent steam launch to iron-pier to take 3 cases of ammunition to the detachment at Dos Cruces, and one day's provisions were taken to the other detachment by the messmen.
27-28	do	At 8.45 p. m. musket-firing was heard toward the city, at which the Oquendo reported that infantry firing had been seen in the direction of Dos Caminos del Cobre, which report was transmitted to the Flagship. At 9.00 a. m. Ensign J. M. Arancibia relieved the officer of the torpedo station (hut) at Estrella. Flagship made signal to hold divine service.
28-29	do	At 1.00 p. m. one day's ration were sent to the detachment at Dos Cruces. At 4 p. m. sent one day's ration and a change of clothing to each person in the detachment at Dos Caminos del Cobre. At 6 p. m. semaphore showed signal:—"The enemy opens fire to E'd," lowering it at 6.30; during this time heard cannon firing in the direction indicated. At 1.00 p. m. Viscaya signalled to Teresa that "four cruisers were at entrance of harbor and distant four miles," the Amazonas, two yachts, and two merchantmen; at same time heard cannon and musketry firing in the direction of Daiquiri. Enemy's search-lights illuminating entrance all night.
29-30	do	During first watch the Viscaya informed the Teresa that there was a destroyer within a thousand metres of the entrance to the harbor. At midnight the Viscaya informed the Teresa that the Amazonas and a small vessel were three miles off the port entrance, and at 12.30 that the Morro was firing with rifles at a boat which was within 180 metres of the entrance. The destroyers came in, and at 7.30 a. m. the Alvarado left. The steam launch was sent with rations to the detachment at the Cruces.
June July.		
30—1	do	7.30 a. m. musket-firing was heard in the direction of Dos Caminos. At every hour of the first watch shots and musket-firing were heard, apparently in the direction of Dos Caminos del Cobre. At 11.00 a. m. an explosion was heard resembling cannon fire near the land, and a shell struck near the bow; we then beat to General Quarters for action and kept all hands at their stations.

SPECIAL BULLETIN
U. S. FLAGSHIP NEW YORK.

ABSTRACT OF THE LOG OF THE CHRISTOBAL COLON FROM APRIL 8TH TO JULY 3RD, 1898.—*Cont.*
(The Sea-Day from Noon to Noon was used.)

Date. July.	Position.	REMARKS.
1—2	At anchor in harbor of Santiago de Cuba.	At 12.30 p. m. firing was heard between the town and Siboney, the enemy firing on the port. Twice artillery and musket-fire was heard at the beach, that of the enemy's Squadron at the port, ceasing at 2.00 p. m., but continued that at the land. The Flagship made signal:—"For to-morrow, guardship, doctor and chaplain, the Colon." At 5.00 p. m. artillery and musket-firing again heard. Ambulances were seen from on board taking wounded to the hospital. At 2.00 a. m. five volleys of musketry were heard at Punta Blanca. At end of Mid watch Flagship made signal:—"Light fires under all boilers," and having asked if we were to light fires at once they replied "No, have steam ready by two o'clock in the afternoon." At 5.00 a. m. musketry fire was heard toward the town and shortly afterward fire was opened on the batteries and the bay. Beat to General Quarters for action, kept all hands at their stations and loaded starboard battery.
2—3	do 6 p. m. weighed anchor. 8 p. m. anchored.	

NOTE.—The columns for the 2nd and 3rd are entered up to midnight; but someone has torn out the page of remarks for that day.

PROFESSIONAL NOTES.

SHIPS OF WAR IN ACTION.

We are indebted for the following article, whose importance it is not easy to overestimate, to one of our United States correspondents, who writes: "I have been engaged with a colleague in a critical examination of the operations of the American navy during the present war. Circumstances have given me abundant opportunities to discriminate between the various reports, official and unofficial, which have been published here on this subject. I send you the result, and I am quite certain that every fact stated by me will, sooner or later, be verified in official quarters. The labor which this article has entailed has been enormous, owing to the numerous wild newspaper statements which have had to be hunted down and proved to be untrue before the article could be presented in its present shape."

The net result of the first two months' active naval warfare between the United States and Spain points to a continuation of the policy of building sea-going battle-ships and armored cruisers by all the ambitious naval powers of the world. Between the battle of Manila, fought on May 1st, and the complete destruction of Admiral Cervera's fleet outside of Santiago on July 3rd, the gun-fire on both sides has demonstrated that the ordinary planting of unarmored ships offers no obstacle to the direct fire of common shell timed to burst in the interior of the vessel. At the same time, although the armored sides of the American battle-ships have been struck on several different occasions by Spanish shot or shell, no damage whatever has followed the impact.

The early morning engagement at the battle of Manila, according to Admiral Dewey's official account, lasted one hour and fifty-four minutes. At the end of this time the Reina Cristina, the Castilla and the Don Juan de Austria—the three largest Spanish vessels—and a gunboat were on fire from the effect of the American shells. The range varied from 5000 to 2000 yards, and there is reason to believe that most of the damage was done by the 6-inch guns. Captain Gridley, of the Olympia, in an account of the action given by him shortly before his death, says that one 8-inch shell, which struck the Reina Cristina near the stern, killed and wounded seventy men. Past-Assistant Engineer Beach, of the Baltimore, who visited all the sunken ships after the battle, says that "one smokestack of the Castilla was struck eight times; and the shells through the hull were so many and so close that it is impossible that a Spaniard could have lived on her deck. The other large ship, the Reina Cristina, was perforated in the same way." Mr. J. L. Stickney, the correspondent of the *New York Herald*, who was formerly an officer in the United States navy and acted as Admiral Dewey's aid during the engagement, says that the captain, chaplain and ninety others were killed and six wounded on

the Castilla, and that 150 were killed and ninety wounded on the Reina Cristina. But we have already seen that 29 per cent. of the killed and wounded on the Reina Cristina was the result of one 8-inch shell, and it is therefore fair to draw the conclusion that well-aimed, properly-bursting shell-fire will be terribly destructive to the crews of unarmored vessels.

Let us now turn to the effect of the badly-aimed Spanish fire on the American ships. One shot struck the Baltimore and went clean through both sides, without injuring anyone and without doing any material damage to the ship. A second shot struck the same vessel, ripped up a portion of her main deck, exploded a box of rapid-fire ammunition, and injured eight men; the only casualties sustained by the Americans during the action. A shell entered the Boston's ward-room, just above the water-line, exploded within 5 feet of Paymaster Martin without injuring him; gutted Ensign Dobridge's stateroom, and set the furniture and combustibles in it on fire. The flames were soon put out with a hose, previously provided for that very purpose. A second shell set fire to the Boston's port hammock nettings; but this blaze was soon extinguished. Other shells hit the masts and rigging of the American ships; one of them burst near Admiral Dewey, on the bridge of the Olympia, and another passed in front of Captain Wildes, on the bridge of the Boston. Captain Gridley says the Olympia was hit thirteen times without injury. It is evident, therefore, that the Spaniards had no lack of guns or ammunition, and that their failure to inflict more damage on their adversaries was the result of bad markmanship, due either to want of practice or to want of coolness in serving the guns. Let us suppose, for the moment, that the Spaniards had had plenty of gun practice—a very improbable supposition—that we might infer that the heavy and constant fire of the American ships had so flustered them as to destroy the accuracy of their aim. We might parallel such a supposition by pointing out that while the two fires started on the Boston were soon extinguished, the fires on the Spanish ships were allowed to get beyond control.

Leaving aside for the moment, to return to it later, the question of shell-fire, let us examine some aspects of the battle of Manila which have an important bearing on the future of naval warfare. The most cursory examination of the official account of the engagement, as made public by the Navy Department at Washington, shows that many important portions of it have been suppressed, doubtless for the good of the public service. Nothing is said in it, for example, about the shortness of ammunition in the American fleet after the battle was over, though the fact was made sufficiently notorious through the hurried orders telegraphed to the United States cruiser Charleston at San Francisco to ship a large supply of powder and projectiles, and to proceed at once to Manila. The correspondents of the European newspapers in the Far East have also frequently alluded to Admiral Dewey's lack of ammunition until fresh stores arrived on June 30th on the Charleston. A remarkably frank private letter, written by a staff officer of the American fleet to a friend in New York, and published in the *Sun* of June 15th, gives us a good deal of light on this necessarily delicate matter. The first extract from this letter had better be given verbatim: "At 7.30 we got the signal to haul off, and the captains to go aboard the flagship. Up to this time, while some of the smaller craft had run inside the navy-yard slip, we could not see that we had done much damage, and we had not been hurt. We felt very sick at our apparent lack of success. We only

knew later how solemn the conditions were. The commodore was much depressed. Half the ammunition on our ships had been expended, and he began to wonder if he might not better haul off and try to blockade the place. The reply was that if he did this the enemy could harass us, keep us on the *qui vive*, and force us to expend ammunition in night attacks."

The staff officer's letter continues to say that while the captains were in consultation with the Admiral three of the Spanish ships were seen to be on fire. It also says that when the second attack began at 11.16 the Baltimore took the lead because "the Olympia had only thirty-seven shots left for her big guns." Now, we learn from Captain Gridley's account, previously referred to, that the Olympia fired forty-three shots from her 8-inch guns during the engagement. Adding Captain Gridley's forty-three shots fired to the staff officer's thirty-seven shots left after the early morning fight, would give eighty rounds in all, or only twenty for each of the four 8-inch guns. Suppose the Olympia used her 8-inch guns as little as possible during the second engagement, Captain Gridley's account goes far to corroborate that of the staff officer, since forty-three is three more than the half of eighty, and the rapid expenditure of ammunition during the first engagement would explain Admiral Dewey's reason for signalling to cease fire and to order the captains to come on board the flagship, so that he might ascertain how many projectiles each had left on his ship. It is also at least a curious coincidence that English critics of American warships have repeatedly referred to their smallness of ammunition capacity—a fault corrected in the later battle-ships—as likely to prove their chief drawback on active service. Mr. H. W. Wilson, for example, in his "Ironclads in Action," in discussing the United States navy, takes this view when he says: "Only the actual trial of war can settle the question whether, with a given weight for guns and ammunition, it is better to have more guns and less ammunition, or fewer guns and more ammunition"—page 300. That, it may be remarked, depends entirely on the accuracy of the firing.

Two other points in the staff officer's letter may as well be mentioned here. "All that morning (April 30th)," the letter says, "and all day Friday (April 29th) we had been stripping ship and chucking overboard spare loose articles, tables, mess chairs and benches, ladders, everything that would afterward make trouble. All joiner and woodwork on gun deck was torn out and thrown away." Again the letter says: "You never anywhere saw such a wreck as my room was. It got no shot in it, but our own 8-inch guns, fired right across the deck, tore it all to pieces. Everything breakable was broken, and the bulkheads were all started; all the bookshelves were torn out and everything—clothes, electric fan, books, 'baccy, curios, and the rest—was on the floor in one mass. Can you picture it?" The same account also says: "Not one of our boats had we left after the scrap. Four of them we let fall from the davits—what was left of them, and the others will take no end of work to make them hold water." Returning to the effect of shot and shell-fire, we find that the next event of the war in this direction was the disablement of the American torpedo-boat Winslow, on May 11th, by a Spanish land battery in Cardenas harbor. The battery consisted of several 4-inch guns firing at a range of 2500 yards. Although many shots were fired at the Winslow, only two took effect. The first of these was a shell which burst on the deck of the torpedo-boat, killing Ensign Bagley and three men, and wounding two

others. The second shell disabled the Winslow's engines and boilers, wounding two men in the engine-room. As the Spanish battery used smokeless powder, it could not be located by the attacking ships. If the account of the Cardenas fight published in the *New York Herald* of May 14th be true, the Winslow had a very narrow escape from total destruction. A shell from the Spanish battery is said to have struck the forward port torpedo of the vessel and to have passed through the gun-cotton charge without exploding it.

In the attack by Admiral Sampson's fleet on the fortifications of San Juan, Porto Rico, on May 12th, eight shells struck the armored sides of the battle-ship Iowa without doing the slightest damage. A 6-inch shell struck one of the boats in the vessel, scattered the splinters of the boat in all directions, then burst, sending fragments which made fifty wounds in the ship, including four or five perforations of the gun deck, which it set on fire, and a hole in one of the funnels, fortunately injuring only three men. Another shell killed one man and wounded four others on the superstructure of the armored cruiser New York during the same action.

When General Shafter's army began to disembark at Baiquiri on June 22nd, the second-class battle-ship Texas was ordered to shell the western batteries at the entrance to Santiago harbor. A 6-inch gun in one of these batteries discharged a shell which struck the Texas on the port bow between the gun deck and the spar deck, bursting in the forward compartment where there were six 6-pounder guns, with their crews at quarters. Though the steel plating of the ship's side was 1¼ inch in thickness, it did not explode the shell, which passed through it as if it were so much paper. About 7 feet from the starboard side it struck a heavy metal stanchion, shattering 2 feet of it into fragments, and burst. The base of the shell ploughed a furrow along the deck until it met one of the ship's ribs, where it broke into two pieces, both of which struck a cable reel, 4 feet in diameter, consisting of 2 feet of hemp hawser and 2 feet of oaken drum. The cable was cut completely through and the oaken drum smashed into splinters. Showers of steel splinters from the shell itself and the metal stanchion which it struck swept along the starboard side of the ship, breaking gun fittings, cutting off heads of bolts, and stripping off paint. One man was killed and eight men were wounded by this shell, and it is especially worthy of note that the smoke from the explosion forced its way down the ammunition hoists and into the forward compartments of the ship, so that for a few moments the crew in that part were almost suffocated. This completes the list of casualties on American ships from shells up to June 30th.

During May and June four attempts were made by Spanish torpedo-boats to injure American warships. The first of these was at the battle of Manila, on May 1st, when two torpedo-boats came out together from Cavite and advanced towards Admiral Dewey's fleet. They were soon seen, and one of them was sunk and the other so badly injured that it had to be beached before either of them came within the maximum torpedo range of 1000 yards. The second attempt was made at night on May 30th, at Santiago, which in competent hands would probably have resulted in the destruction of the Texas. The Spanish torpedo-boat destroyers Furor and Pluton, credited with 28 and 30 knots respectively, were within 500 yards of the Texas when discovered by her searchlights. In spite of a hot fire they retreated back into Santiago harbor without serious injury. Next day two automobile torpedoes were found floating on the surface

of the sea not far from where the Texas had been the night before. One of these torpedoes was in good order ready to explode. The other, through the carelessness of the men who fired it, had only a practice head in it and could have done no damage under any circumstances. On the night of June 3rd the New Orleans discovered a possible torpedo-boat within range of her guns and promptly opened fire. The New York and Massachusetts quickly followed her example, and finally the Oregon sunk the vessel, whatever its character may have been, with a 13-inch shell. During daylight on June 22nd the torpedo-boat destroyer Terror came out of the harbor of San Juan, Porto Rico, and by keeping under cover of the Spanish cruiser Isabella II, attempted to get within striking distance of the United States auxiliary cruiser St. Paul. When the Terror came within a range of 6000 yards the St. Paul let fly her whole broadside, consisting of three 5-inch guns, two 6-pounders, two Hotchkiss rifles and two 3-pounders. Although the guns were said to have carried the range, none of them did any serious damage to the Terror. After firing some fifty or sixty shots at the torpedo-boat destroyer—she fired 100 shots altogether between the two vessels—the St. Paul discharged a last 5-inch shell, which struck the Terror on the port side, near the stern, went clear through into the engine-room, took off the head of the chief engineer, the legs and arms of the assistant engineer, and mortally injured one of the crew who was in the engine-room at the time. It also completely wrecked the Terror's engines, and left her in such a sinking condition that she had to be beached.

Fixed submarine mines, though laid down by the Spanish in considerable numbers, did not prove effective in any single instance. Their greatest chance of success was at Manila, where two separate mines were exploded prematurely as Admiral Dewey's flagship, the Olympia, was advancing to the attack at Cavite. As the American admiral had no knowledge of where these mines were placed, it is possible that in more skilful hands they might have destroyed the Olympia and the Baltimore. The mines which were said to be so plentifully strewn in the narrow and tortuous channel leading to the harbor of Santiago were practically needless precautions, since a few batteries of modern high-power guns could have blocked the channel. Between June 8th and 11th the propellers of two United States warships loosened two submarine contact mines in Guantanamo harbor. On examination it was found that the failure of these mines to explode was due to the incrustations of shell fish on the plungers, which were thus prevented from breaking the bottle of sulphuric acid which was to set off the mine—probably by mixing with chlorate of potash and sugar.

There is no reason, at present, to believe that the numerous bombardments by the American fleet of fortified places in Cuba and Porto Rico did any serious or permanent harm to the earthworks which protected most, if not all, of the Spanish high-power guns. It is true that the older masonry fortifications with their obsolete guns suffered a good deal of damage, but this was only to be expected, as it evidently was, even by the Spaniards themselves. Some good work, however, was done by American gunboats in destroying the smaller shelter forts which the Spaniards had erected along the coast of Cuba to prevent the insurgents from smuggling arms into the interior. At Guantanamo American warships aided a party of 800 marines, who had been landed, by shelling the woods in which Spanish soldiers were ambushed.

The battle of Santiago, ending with the total destruction or capture of Admiral Cervera's fleet, marks the virtual culmination of the naval warfare between the United States and Spain. Although it occurred in broad daylight, and although the fight was a running one, and singularly free from complications, the accounts which we have, both official and other, are full of contradictions on minor points. Taking Admiral Sampson's official report as our main guide, we learn that at 9.30 a. m., on July 3rd, the armored cruiser Brooklyn, and the battle-ships Texas, Iowa, Oregon and Indiana, were on blockading duty, lying in a semicircle in the order named, outside the narrow entrance of the channel leading to the harbor of Santiago; the Iowa lying directly opposite the harbor entrance about four miles from land, at 9.31 first sighted Admiral Cervera's flagship, the Infanta Maria Teresa, coming through the channel. She was followed at intervals of 800 yards by the Vizcaya, Cristobal Colon and Almirante Oquendo in the order named, and at intervals of 1200 yards by the torpedo-boat destroyers Pluton and Furor. On seeing the signal hoisted by the Iowa, Commodore Schley, on board the Brooklyn, and in command of the fleet in the temporary absence of Admiral Sampson on the armored cruiser New York, ordered a general movement inward of the semicircle of blockading ships. The Iowa at 9.40 fired the first shot at a range of 6000 yards, and continued firing as she approached the harbor entrance, until it was seen that the Maria Teresa would pass, heading westward, between the land and the Brooklyn, which had been lying to the west of the channel, about two miles from shore. The Brooklyn, which had been heading eastward, to head off the Maria Teresa, delivered a raking fire from her port batteries at 1500 yards range. The Texas, the next ship to the Brooklyn in the blockading semicircle, opened fire on the Teresa at 4200 yards range. The Iowa, at 2500 yards from the Teresa, put her helm to starboard and delivered her broadside fire. The Oregon, the fastest vessel in the squadron except the Brooklyn, and the Indiana, which formed the most easterly end of the blockading squadron, also opened fire at long range on the Teresa as she came out of the channel. For thirty-five minutes the battle raged fiercely, the whole Spanish fleet in its original order turning line ahead westward, close to the shore; and the American fleet, in its blockading order from west to east, also gradually forming line ahead, with the Brooklyn leading. Fifteen minutes after the action began the Teresa was seen to be on fire. She soon dropped behind and was beached 6½ miles from the harbor entrance. Meanwhile the Vizcaya, Cristobal Colon and Oquendo were gaining on the four battle-ships, and were concentrating their fire on the Brooklyn. Then the Oquendo dropped out of line and was beached half a mile further on than the Teresa, leaving the Colon and Vizcaya with apparently nothing but the Brooklyn to stop them. The Oregon, however, the most easterly vessel but one in the semicircle, proved to be much faster than the Spaniards had anticipated, and, having successively passed the Texas and Iowa, came up within 600 yards of the Brooklyn and kept her position until the battle was over. This must have been about 10.30, when the Oquendo was beached. The Brooklyn and Oregon continued chasing and firing at the Vizcaya and Colon. At 10.53 the Vizcaya was seen to be on fire, and at this time the Colon, previously astern, passed her on the landward side, showing much faster speed for the moment than the Brooklyn. The Vizcaya was turned toward the shore and run aground some minutes later, twenty-one miles from the harbor entrance,

the corrected time at which firing at her ceased being given by Lieut. Sharp, of the Vixen, at 11.18. By this time the Colon, hugging the shore, was six or seven miles ahead of the Brooklyn and Oregon. The Brooklyn at once steered for a point near Cape Cruz, which the Colon must necessarily pass, while the Oregon kept right behind to check any attempt at doubling back. Between 11.18 and 12.50 no shots were fired, but at the latter time the Oregon tried her 13-inch guns and found that they carried beyond the Colon, whose spurt had been short and whose speed had gradually decreased. The Brooklyn then opened with her 8-inch guns, and after both ships had fired four or five rounds the Colon ran ashore and hauled down her flag at 1.20 p. m., being then forty-eight miles from the channel entrance. By this time the Texas and the New York were approaching, though not within range. The New York, Admiral Sampson's flagship, was four miles east of the blockading station when the action began, being on her way to Siboney, where the Admiral was to hold a conference with General Shafter. She at once turned back and was in at the death, without having been able otherwise to render effective aid.

Let us now return to the two torpedo-boat destroyers Pluton and Furor. When they appeared at the channel entrance the Indiana, Oregon, Iowa and Texas, which had all been firing at longer or shorter range at the Spanish armored vessels, with one accord turned their secondary batteries on the destroyers, aided by the converted yacht Gloucester with a battery of 6-pounder guns. The Gloucester exposed herself in the most daring manner to the much superior guns of the destroyers, the armored cruisers and the land batteries. The fate of the destroyers was ultimately determined by the Gloucester and the Indiana, one being sunk and the other being driven ashore totally disabled within twenty minutes after coming into action.

As regards speed, the Spanish ships came through the channel at from 8 to 10 knots, and this was increased as soon as they reached clear water. The Colon, the only ship which had a chance to run away, showed her heels to the Brooklyn and Oregon for a short spurt, but soon fell down again. Admiral Sampson has carefully estimated her speed from start to finish at 13.7 knots an hour. The Brooklyn had only one pair of engines coupled up and could not afford the time to throw in the forward pair; as she gained steam her speed rose gradually from 14 to 16 knots. The battle-ship Oregon also ran up to 16 knots and had plenty of steam long before the others. The Iowa and Indiana were falling behind before the Vizcaya ran ashore, the Texas was gaining on the Colon during the last hour of the chase.

Only one man was killed and one wounded on the United States ships during the whole engagement. Both these casualties occurred on the Brooklyn, which was also struck by twenty whole shot without injury, besides being hit many times by pieces of bursting shell and small shot from machine guns. Two 6-inch projectiles struck the Iowa; one of these lodged in the cofferdam without exploding; the other entered the starboard side at the berth deck, broke off the hatch plate of the water-tank compartment and exploded; perforated the walls of the chain locker, starting a small fire, which was soon extinguished, while one fragment cut a link of the sheet chain wound round the 6-pounder ammunition hoist, and another fragment perforated the cofferdam on the port side and slightly dished the outside plating. The Oregon was struck three

times, and two of these hits were only fragments of shells. The Indiana was struck twice without injury, and no hits are mentioned by the Texas.

The only ammunition expenditures made public are those of the Brooklyn and Iowa. The Brooklyn fired 100 8-inch, 473 5-inch, 1200 6-pounder and 200 1-pounder. The Iowa fired 31 12-inch semi-A. P. shell, with full charges; 35 8-inch common shell with full charges, 251 4-inch R. F. common shell, 1056 6-pounder common shell, and 100 1-pounder common shell. Trouble and delay were caused by the jamming of the locks on the Brooklyn's 8-inch guns, and several of the 5-inch guns were rendered useless before the end of the battle by failure of the elevating gear.

Thus far every statement made about the battle of Santiago has been strictly taken from the official accounts of the admiral, commodore or captains. A mail letter by the correspondent of the Associated Press, which has intrinsic evidences of truthfulness, gives an account of a visit paid to the Spanish ships by a board of inspection appointed by Admiral Sampson. The first ship examined was the Cristobal Colon, which was found to have been struck only six times by large projectiles, *i. e.* over 6-pounder. This tallies with the statement in the official report by Admiral Sampson that "the Cristobal Colon was not injured by our fire." However, as we now know that the Colon had no turret guns, it would have been madness for her to persist in trying to escape when the Brooklyn and Oregon, both superior in fire and in speed, were within range and between her and the open sea.

The Vizcaya, the next ship examined by the board of inspection, was hit with large projectiles fourteen times, by 6-pounders eleven times and an unknown number of times by 1-pounders. These fourteen shots, between 5-inch and 8-inch, were apparently sufficient to tear the Vizcaya almost to shreds above the armor belt. The flagship, Infanta Maria Teresa, was the only vessel struck by a 12-inch or 13-inch shell during the engagement. Two projectiles of this calibre struck her, both going clean through the unarmored sides of the ship. There were fourteen guns of either 12-inch or 13-inch calibre in the attacking fleet, but there is good reason to believe that two of these were undergoing repairs and were not fired during the action. It will be remembered that the Iowa, which was in action thirty-five minutes, fired thirty-one 12-inch shells. If the other battle-ships used proportionally the same amount—and the Oregon and Texas were much longer in the action—the total fired would be 108, giving less than 2 per cent. of hits. The most destructive shot which struck the Teresa was an 8-inch shell from the Brooklyn, discharged at 1000 yards range. This entered the port side, just forward of the beam, and exploding, cleaned out the deck, including four gun crews. Admiral Cervera afterwards said that it was this shell which set the Teresa on fire, and as either it or some other projectile had cut the fire main, it was found impossible to put out the fire, which led to the Teresa's early surrender. The Almirante Oquendo presented the most typical appearance of a ship defeated in a modern naval action. Her upper works were cut into ribbons and the number of dead was very large. She received a good part of the fire of the 6-pounders and 1-pounders intended for the torpedo-boat destroyers which followed her. She was hit on the port side, which was turned toward the attacking fleet, four times by 8-inch shell, three times by 4-inch, twice by 6-inch, and forty-two times by 6-pounders. The attacking fleet, besides 12-inch

and 13-inch guns, had thirty-two 8-inch, fourteen 6-inch, twelve 5-inch rapid-fire, six 4-inch rapid-fire, and seventy-two 6-pounders. To enable the curious to estimate the percentage of hits, the armament of the Brooklyn and Iowa, which gave their expenditure of ammunition, is as follows: Brooklyn, eight 8-inch, twelve 5-inch rapid-fire, twelve 6-pounders and four 1-pounders. The Iowa had four 12-inch, eight 8-inch, six 4-inch rapid-fire, twenty 6-pounders and four 1-pounders.

None of the ships in action used smokeless powder except the Colon, and the fumes of brown cocoa powder were very distressing to the American gunners. Although there was a slight breeze, the clouds of smoke seriously interfered with the aim of the gunners, especially those with the large guns, while the fumes were so choking that many of the gunners had to wrap damp towels over their mouths. Both range-finders and range-indicators were upset and rendered useless by the shocks produced by the firing of the guns. One end of the deck of the Texas was torn to pieces by the shock of one of her two 12-inch guns. The noise of the firing prevented messages from being carried by the speaking tubes, and at least one messenger delivered a wrong message. None of the commanding officers used the conning tower; all of them stood out in the open. Most of these facts have been gleaned from mail letters to the New York *Commercial Advertiser* by an officer on board the Iowa. These letters are corroborated to such an extent by the official reports that they must be regarded as trustworthy.

The first lieutenant of the Vizcaya, in an interview with a correspondent of the New York *Sun* the day after the battle, gave the following reasons for the defeat of the Spanish: "The fire from your guns was terrific; shells were continually striking us at all points, and it seemed as if each shell started a new fire wherever it struck. Our men were driven from their guns by the rain of secondary battery projectiles and by the fire and smoke of burning wood on our ship. In twenty minutes fires had started fore and aft. The decks and the joiner work in the officers' quarters and all along the berth deck took fire, and it was no longer possible to keep our men at their guns."

It is plain from this that the Americans won by bravery, coolness, discipline and drill. It is equally clear that the Spaniards were demoralized by the superiority of the Americans in rapidity and effectiveness of fire. The lesson seems to be that in future naval conflicts a superiority, however slight, in the beginning of an engagement becomes multiplied in its effect on an adversary by something like geometrical ratio, since the moral disorganization produced, by cutting off the return fire, encourages accuracy of aim on the other side as fast as ranges are found by actual trials. This, however, does not settle the question of whether many guns with light crews would be superior, other things being equal, to fewer guns with heavier crews, or with a competent reserve to take the place of men put out of action. Another most important deduction is that shooting in action with high-power guns by no means yet compares in accuracy with practice shooting.—*The Engineer*, Sept. 16, 1898.

THE DESTRUCTION OF THE UNITED STATES BATTLE-SHIP MAINE.

By Lieut.-Colonel J. T. BUCKNILL, late Major R. E.

(*Concluded from page 754.*)

The evidence concerning the explosion by those who saw and heard it, by the wreck itself, and by an expert in explosions has now been examined, and the readers of these articles will be able to judge for themselves whether the large-mine theory adopted by Captain Converse, and afterwards by the court itself (although they located the charge differently), is correct. For my own part the theory appears to be not only improbable, but quite impossible. Firstly, because any such initial cause of the disaster would have given a tremendous shock and explosion, to which every survivor on board would have testified, whereas only one did so—Lieutenant Hood; for Seaman Larsen "heard some explosion in the port gangway; something like an explosion"; he "just turned round, and then the big explosion came" (page 174). He does not testify to an initial great explosion. Lieutenant Hood, however, was very positive about it (page 119): "There were two distinct explosions—big ones, and they were followed by a number of smaller explosions." He adds (page 123): "My belief is that the whole forward part of the superstructure . . . was in the air at the time I saw the second explosion." This was in answer to a leading question from the judge advocate. Secondly, assuming the finding of the court to be correct, it is quite evident that Lieutenant Hood's surmise might also be correct, because a mine capable of driving the keel into an inverted V 34 feet above its normal position would drive that portion of the vessel locally above it into the air, including the superstructure and the decks below it and the magazines below them. This is, of course, a corollary of the finding of the court. But where does it land us? Evidently, if the magazines were driven into the air by the first great explosion of a great mine under the ship's bottom, the contents of the magazines would explode in the air. There was no such phenomenon. Many people saw the crater of explosion; not one even hints at any explosion in the air.

Moreover, the evidence of the entire wreck gives the most positive and convincing proof that the magazines exploded when they were still *in the ship*, and the evidence of the crew of the steam launch shows that it occurred when the ship was still floating alongside the launch.

Thirdly, had the disaster to the Maine been caused by the explosion of a large mine under her bottom, it can be stated with a good deal of certainty by those who are acquainted with experiments with large charges—such, for instance, as the series of 500 lbs. of gun-cotton against H. M. S. Oberon, and especially the last experiments of this series (early in 1875), that the effects would be very different from those which are recorded by the wreck of the Maine.

The final 500-lb. charge fired against the Oberon, as recorded in the *Times*, was submerged 50 feet, and was directly under the starboard side at frame 18 (a curious coincidence). The vessel's back was broken, but the injuries were not so great as to prevent her being towed into shallow

water after the explosion, and the damage, as recorded by the bent or broken bracket plates and angle irons, was confined to the double bottom and to those portions of the double sides below No. 3 longitudinals. Evidently, therefore, if the force applied were increased either by the use of a larger charge, or of a smaller distance, or both, we should foretell with confidence that the general effect would be—bottom blown up and top sides left nearly intact.

This, moreover, would, I think, be anticipated, even in the absence of any Oberon or similar experiments to guide us, for it is evident that the bottom receives the blow flatways, whereas the sides receive it edgeways. In the Maine, however, the sides are gone, and part of the bottom remains. Consequently the sides must have been blown out by the mazazines when still inside the ship, where they could not possibly have been if a large mine acted as an initial explosion in accordance with the finding of the court.

Fourthly. There was no upheaval of water; and a big mine, capable of driving the bottom of the Maine 34 feet up without sending it into small fragments, would naturally carry with it much of the water between the mine and that part of the ship's bottom which gave way at the time of the mine's explosion. The fact that there was only 12 feet between the ship's bottom and the mud is in favor of a small water column, but nevertheless of such dimensions that it could not fail to be observed by many of the survivors who gave evidence on the falling débris. Not one drop of rising or falling water, however, was mentioned in the evidence; although it was a point on which the court sought for evidence very diligently. Of course a large mine, exploded in contact with the bottom, would throw up no water; but such a mine would not bend the double bottom, it would shatter it.

Fifthly. A mine capable of bending the keel and double bottom *and* driving them 34 feet upwards would *not* bend them into a sharp angle—as was done at frame 18 of the Maine—but would produce a dome-shaped wreckage. The remains of the Maine show nothing of the kind.

Other reasons might be given (such as no dead fish floating in the harbor next day, and so forth), but enough has probably been said to raise a grave doubt on the accuracy of the finding of the United States Court of Inquiry. The difficulty was to account satisfactorily for the results of the Maine explosion from internal forces alone, and this, no doubt, weighed so strongly with the court (which from its report evidently examined the matter very carefully and honestly) as to cause it to come to the conclusion that the bottom must have been driven up by some external force. The grave objections and contradictions entailed by this finding, which have been pointed out in these articles, do not appear to have been considered by the court, and at the time of the finding it probably seemed to the court a palpable case of a ship blown up by a mine. The perusal of Captain Converse's evidence, however, shows the reader that he was puzzled, and no wonder. He was suddenly shown a most complicated over-water wreck; also a rough sketch of what was said to be under water, and he could scarcely have had time to sift the very diverse evidence on the explosion itself given by the survivors and spectators from a small distance.

The doubt as to the accuracy of the court's finding would become almost a certainty if it be possible to interpret the wreck as the result of internal forces alone.

I feel that this can be done, and beg my readers to patiently examine the following attempt at an explanation which suggested itself after perusing the ingenious theory propounded in a leading article on the subject published in *Engineering* on April 22 last. This theory, that the bottom was bent by the sinking of the fore part of the Maine when the after part was still water-borne, the sides and decks of the midship having been removed by an internal explosion, and "that the after part may have moved after the stem became embedded in the mud," appeared to me to account for the wreckage, whereas the finding of the court did not.

On examining the theory the following difficulties, however, presented themselves:

1. Fourteen feet of water under the bottom of Maine would scarcely give a sufficient scope for the suggested action.

2. Which, moreover, relies on Exhibit H. Expert diver Dwyer, however, disapproved its accuracy. The flaps marked A B on the sketch, instead of being hinged horizontally (as shown), must be hanging on nearly vertical hinges, the fore body lying on the mud on its starboard beam ends ram down, instead of as shown in the sketch.

Nevertheless, this theory was a brilliant and clever conception, and very helpful, as indicating the kind of action which may have produced the wreck, without resorting to the idea of a great submarine mine with its accompanying treachery.

My theory is as follows:

1. That a small initial explosion occurred in or close to the 6-inch reserve magazine—port side—about frame 27 (see Figs. 1 and 2, page 505, *Engineering*, April 22).

2. That the contents of this magazine immediately became involved. N. B.—The contents of this magazine first stated to be only 200 lbs. of saluting powders was afterwards corrected. "The saluting powder not being shown so as to require a new supply or a new requisition, we must have had very much more than 200 lbs." . . . "Could not say even approximately how much was in that magazine" (Lieut. Holman, page 36).

The energy of this explosion would be mainly directed to the lines of least resistance, viz. to the adjoining 10-inch shell-room starboard of it, and to the 6-pounder magazines forward, and to starboard of it. At the same time a tremendous pressure would be exerted upon the longitudinal bulkhead to port which separated it from coal bunker A16.

3. This pressure being increased by the further ignition of parts of the contents of the 10-inch shell-room and of the 6-pounder magazine, it would find a vent, and at the same time involve the 10-inch magazine under the starboard turret, as also the forward 6-inch magazine. The principal weight of the ship at this part of the ship being on the starboard side, if the initial explosion occurred on the port side as suggested, the result would be decks lifted, then port side blown out.

4. Having found these vents, the cumulative explosion which lasted, perhaps 2 seconds, perhaps 3 seconds, and possibly more, and which was so graphically described by one of the survivors—as simply "the roaring of the ship," would be discharged through these vents toward port—driving everything before it to port that previously existed in that part of the ship.

5. The final explosion of the large 10-inch magazine would then occur and drive out everything before it within 50 degrees or 60 degrees of the zenith, but being a slow-burning powder—"brown"—its principal effect

would still be towards the vents already opened, viz. upward and to port, but with sufficient violence to send the débris to the port side of the City of Washington moored 300 feet on the port quarter of the Maine.

The principal discharge of this huge accumulative explosion being to port, and its duration being an appreciable time period, the ship itself in the vicinity of frame 27 was evidently subjected to a very powerful reactionary force; in fact, the ship itself was like a floating rocket—burst near the centre—and driven sideways by reaction to starboard.

When the great final explosion occurred, completing the demolition of the ship's sides, decks, etc., it would also drive the double bottom downwards; but the mud being so close, a reaction or recoil would ensue, tending finally to buckle the bottom upwards, and this would occur at the same moment of time that the wall of water surrounding the crater of explosion fell back to the axis of explosion after the gas pressure had expended itself. Moreover, at this same instant, the after body of the Maine would be subjected to a water pressure on its immersed cross-section tending to drive the after body forward—but I take it that this force would be small in comparison to the reactionary force to starboard due to the explosion itself during its accumulation of pressure. Whether so or not, there were evidently several important forces, one tending to drive the after body forward; another tending to drive the whole ship to starboard, and to rupture her at its point of application; and another tending to buckle the ship's bottom upwards. At the same instant of time the bow chain by which the vessel was singly moored is strained to port.

Evidently these forces would tend to bring about precisely what is now known about the wreck. The bow "sunk like a shot" one witness said, and the momentum of the ship to starboard would bring the fore body into the position described by the professional divers. The simultaneous motion of the after body to forward and to starboard would crumple and twist that portion of the double bottom still remaining in such a manner as not only to twist the bent keel at frame 18 in the manner of a knuckle joint, but also to account for the longitudinal corrugations in the inner skin of the double bottom noted by ship's diver Olsen.

There is nothing in the least degree improbable in the above theory of the Maine disaster, and it agrees with the wreck, which, after all, is the most important and reliable witness. It is based principally on the reaction caused by the explosion itself to starboard horizontally during the whole time of the "roaring," also to the reaction from the muddy bottom from the final great explosion. It takes into consideration the bow chain and the inrush of water (with its floating bodies) to fill the crater of explosion.

The proximate cause of the explosion may never be known. If due to any neglect the culprit may be dead; and if he still live he would naturally take considerable care to let it remain unknown. For my own part I think it was due to coal heating in bunker A16, which was what is known as a "difficult bunker," *i. e.* one that it was not easy to fill or empty. It was full of soft coal "Pocahontas" (page 152), 40 tons, and had been so for some time. There was evidently some fear as to coal heating in the bunkers, although nothing of the kind had occurred in the Maine. Her bunkers were fitted with "the usual thermostats" (page 154), but "they did not work very well. Sometimes they rang when there was no coal in the bunker." The United States' practice appears to be different

from H. M. navy as regards the lining of magazines. An officer of H. M. fleet, high in command, informs me that "the powder magazines in our service are always lined with wood, so that the powder cases can never touch the steel or iron bulkheads—whether the adjoining compartment is or is not a coal bunker. As a rule, the magazines are not next to the coal bunkers—indeed, it is quite the exception if they are." The evidence on the Maine showed that a powder tank in the 6-inch reserve magazine lay against the steel bulkhead, metal to metal. In fact, there were only two thicknesses of this metal in contact between the soft coal and the saluting gunpowder, and this although it was considered necessary to equip the coal bunkers with thermostats. Comment is unnecessary.

Again, as regards rockets, which have ever been such a fruitful source of explosions, Lieutenant Holman was asked (page 141) to "state where rockets and blue lights and such things were stowed on board the Maine," and replied, "In the chart-house or the pilot-house upon the bridge."

Q. "All of them?"

A. "All of them, I think. I do not know of any having been moved from there. They were stowed there originally, and I know of no move having been made."

No other witness was asked about the rockets. On the whole there seems to be no necessity for going outside the ship to account for the primal explosion.

Of course it may have been due to a small contact charge, but the only evidence in favor of it is a "cock and bull" story in an anonymous letter, which was treated by the court with the silent contempt it deserved.

It therefore seems to the writer that Americans should dismiss from their minds the idea that the Maine was blown up by the Spanish authorities, or with their cognizance—all the evidence pointing entirely in the other direction, viz. that the disaster was purely accidental, and that the explosions were confined to the interior of the ship.

APPENDIX.

The contents of the forward magazines were as follow: Forward magazine—99 full charges, 6-inch B. L. R.; 164 reduced charges, 6-inch B. L. R.; 146 common shell, 6-inch B. L. R.; 100 armor-piercing shells, 6-inch B. L. R.; 24 shrapnel, 6-inch B. L. R. Forward fixed ammunition-room—1672 rounds, 6-pounder steel shell; 1232 rounds, 6-pounder common shell; 297 rounds, 6-pounder blank; 1020 rounds, 1-pounder steel shell; 660 rounds, 1-pounder common shell; 10,000 rounds, ball cartridges, 6 millimetres; 9000 rounds, ball cartridges, .38 millimetres. Forward 10-inch shell-room—90 common shell, 10-inch B. L. R; 74 armor-piercing, 10-inch B. L. R.. Forward 10-inch magazine—92 full charges, per 10-inch B. L. R.; 88 reduced charges, per 10-inch B. L. R. Reserve magazines—113 full charges, per 6-inch B. L. R.; 51 reduced charges, per 6-inch B. L. R.; 3400 rounds spare saluting powder in tanks; 100 lbs. shrapnel and impulse powder.

But Captain Wainwright (page 270) testified to the recovery, by divers, of 35 powder tanks, 6-inch, and 10 powder tanks, 10-inch, and that powder was found in two of them . . . showing that the whole of the above contents of the forward magazines could not have exploded—that a certain portion escaped ignition.—*Engineering.*

THE DESTRUCTION OF THE UNITED STATES BATTLE-SHIP MAINE.

To the Editor of Engineering.

Sir.—Like all other Americans, I have taken great interest in the causes of the Maine disaster, and have read all the official documents and many private essays on the subject. In Europe I have observed a tendency on the part of most writers to become so fascinated with the problem of how the explosion *might* have occurred from internal causes, that it ends in their losing entire sight of the simpler theory of an external explosion, which they seem to think is necessarily an accusation of complicity on the part of the Spanish government.

There has lately appeared in *Le Yacht* an able article by "V. G." Later, an exhaustive paper by Captain Gereke in the *Marine Rundschau*, both to the same effect; and last, ablest and most prejudiced of all, is the article by Colonel Bucknill, which is concluded in your issue of June 24, and which I have just received.

The colonel's reasoning as to the successive developments and effects of the explosion after it had once commenced is excellent; but in the early part of his article he assumes the planting of a torpedo to be a matter of entirely too much difficulty and publicity; and in his conclusions as to the cause (being in his opinion that of spontaneous combustion in bunker 16), he is eminently unfair in quoting only such evidence as will support his contention. He states that there was soft coal in this bunker "which had been there for some time," and that "the thermostats did not work very well," and that there was evidently some fear as to coal heating in the bunkers, as though this were a unique experience on board ship; but he ignores the statement (page 280) that this bunker was accessible on three sides at all times, and at this particular time on the fourth side, and that it had been inspected that very day by the engineer officer on duty. The colonel quotes the evidence of a gunner, who had been relieved from duty some time before and who, apparently judging from his other evidence, was incompetent, to show that the tanks in the reserve magazine touched the metal bulkheads, while he ignores the statement of the captain to the contrary. He also brings in the opinion of an officer "high in command" in the English navy as to how English magazines are lined and located, and is correspondingly sarcastic on what he assumes to be American methods of lining—or rather not lining—and locating magazines. As a matter of fact, the naval constructors of all nations are perfectly familiar with each other's practice in this respect, and wherever weight and danger of fire can be eased by reducing solid wooden linings to chocks and battens it is done, and the location of the magazines and shell-rooms is nowadays always dependent upon the disposition of the battery. He also ignores the fact that the temperature of coal bunkers and magazines were taken every day, and calmly assumes the temperature of 500 degrees Fahr., which would be necessary to ignite powder to be reached without anybody knowing anything about it. Let any one who has stood watch in a fireroom with the thermometer at only 150 degrees give his opinion.

Some time ago I wrote Commander Kimball, United States Navy, who is now commanding officer of our torpedo-boat flotilla on the Cuban

coast, and one of our ablest torpedo experts, and among other things I asked him about the Maine affair. In his reply he says: "She was probably blown up by an improvised torpedo, planted just ahead of her, and fired when she swung over it." It appears to me that we have the whole matter here in a nutshell. Twenty-five years ago, at the torpedo station at Newport, R. I., one of the frequent exercises of the officers under instruction was the construction of improvised torpedoes. The operation consisted simply in taking an empty powder or fish keg, pitching it inside and out, filling it with gunpowder, inserting an electric igniter through a cork in the bung, lashing a stone to it, and putting the whole in a skiff pulled by two men, carrying it out a couple of hundred yards, heaving it overboard, running the wires ashore and firing it off. The whole operation occupied from two to three hours. Sometimes English lead-covered tape fuze (of which there were some miles at the torpedo station) was used; this tape had been taken from Southern harbors, where it had lain for years under water in the Confederate mine system. It was usually found to be still good, and saved the wear and tear of electric apparatus.

In Havana, as in most other frequented harbors, there are always scavenger boats going about, especially in the vicinity of men-of-war, searching the bottom with tugs and drag nets, and a torpedo of this kind could have been planted in broad daylight by such a boat a day or a week before it was exploded. It could have been brought into direct contact with the ship's bottom by giving a few feet drift to the mooring line, for gunpowder, having only the specific gravity of rice, floats easily. The quantity of powder would have been ample, especially if the operator had had the wit to put four or five igniters in it instead of one, and thus brought about detonation instead of explosion. The first shock to the ship would have been given by this torpedo, but no outward commotion of the water would have been caused, because the line of least resistance was through the bottom of the ship, and it would have driven pieces of the bottom plating into the magazines or shell-rooms with sufficient velocity to have set off the fixed ammunition at least, and probably large filled shell, as experience has shown, especially during the Japan-China war, that this can easily be done by impact; the interior explosion once initiated, the sides of the ship would go out, the deck would go up with flame and débris and the reaction from the bottom would bend the keel.

The motive which impelled the blowing-up of the Maine is a matter that should neither enter into the discussion of the cause and the phenomena, nor cause a bias in either direction.—F. M. BARBER.

TEST OF A SIX-INCH EXPERIMENTAL KRUPP PLATE.

Our naval authorities are to be congratulated on their broad-mindedness and enterprise in adopting a foreign process of armor-plate manufacture which has easily proved itself to be the very best in the world. The Krupp gas process has produced plates which are as superior to the Harvey and Corey plates as the latter plates were to the all-steel and compound plates of an earlier day. Its superiority, as shown by proving-ground tests, was so marked that the English Admiralty at once adopted

it in place of the Harveyized armor, and it is now being placed upon all the newer vessels of their navy; and after the very excellent results obtained at the Indian Head Proving Ground it was inevitable that the new armor should be chosen for all our future ships.

The supreme value of the ever-increasing hardness and toughness which is being given to armor plates consists in the fact that the new plates enable the total weight of armor with which a ship is clothed to be greatly reduced, and the weight so saved may be appropriated to a more powerful armament, or engines and boilers of greater horse-power. Proving-ground tests and experience in actual warfare have shown that the protection afforded by the 15 and 18-inch Harveyized armor of the Oregon is amply sufficient to resist modern high-powered rifles. Although the 18-inch belt or 15-inch turrets of the Oregon type of ship have never been penetrated in an actual engagement, the behavior of inferior heavy armor at the Yalu and at Santiago proves that the heavy Harveyized protection of our ships renders them practically impregnable against shell fired from the distances at which modern engagements will probably be carried on. This being the case, it follows that every improvement in the quality of the later armor enables us, taking the protection of the Oregon as a standard, to make a corresponding reduction in the thickness of the plates.

The improvements introduced under the Corey patents made it possible to increase the tensile strength about 12 per cent. and the elongation about 15 per cent. over that of the Harvey plates; and now the Krupp gas process enables us to produce a plate of such wonderful toughness and hardness that armor 10 and 11 inches in thickness has all the powers of resistance shown by the 15 to 18-inch armor of the earlier vessels.

The Krupp gas process is the latest development in a long line of experiments which has successively provided the world with iron, compound iron and steel, all steel, Harveyized steel, nickel steel, Harveyized nickel steel, reforged Harveyized nickel steel, and Krupp steel. The rights have been purchased in this country by the Carnegie Company, and the second experimental plate recently tested at Indian Head proved to be of exceptionally high quality, even for a Krupp plate. Krupp armor shows remarkable toughness combined with all the hardness of the best face-hardened armor, and, unlike armor manufactured by other well-known processes, the Krupp product maintains these qualities in the very thickest armor.

The plate tested at Indian Head measured 5 feet 8 inches by 9 feet by 6 inches. The backing consisted of 12-inch oak and two $\frac{5}{8}$-inch skin plates secured to the plate by ten armor bolts. The plate and backing were secured to the normal target structure by four holding-in bolts 1.5 inches in diameter which passed through the backing, and by four similar bolts secured to the exposed vertical edge of the backing. The plate has a good surface and general appearance and was hard to a depth varying from 1.5 inches to 2 inches. The plate was so secured that "top" was the right vertical edge.

First round.—The gun used was 6-inch rapid-fire. The charge of powder was 22.25 pounds of Dupont's S. P. F. G. 3; the striking velocity, by chronograph, was 2021 foot-seconds and the striking energy 2831 foot-tons. The projectile used was a 6-inch armor-piercing Carpenter, hardened to 3 inches below the bourrelet, without cap; weight, 100 pounds. The impact was at a point 39 inches from the bottom of the plate, 58.5

inches from the left edge and normal to the surface. The projectile smashed on the plate, only a small part of the point remaining welded in the plate, a large part of the body and base of the projectile being found in one piece in front of the plate. The estimated penetration was 2.5 inches. A back bulge 1.5 inches high was formed on the rear of the plate. The plate was dished in the vicinity of the impact $\frac{1}{16}$ inch. The impact on the surface of the plate covered an area 12 inches in diameter. The plate was not cracked, nor was any injury done to the backing bolts, or structure.

Second round.—The same gun, 6-inch, was used. The charge of powder was 25.8 pounds of Dupont's S. P. F. G. 1. The striking velocity was, by chronograph, 2237 foot-seconds and the striking energy was 3469 foot-tons. The projectile used was a 6-inch armor-piercing Carpenter hardened to 2½ inches below the bourrelet, without cap, weight 100 pounds. The impact was at a point 19.4 inches from the bottom of the plate, 92 inches from the left edge, 39.5 inches from the previous impact, and normal to the surface. The projectile smashed on the plate. A large part of the projectile remained welded to the plate, judging from the smaller part of body and base found in front of the plate. The estimated penetration was 5 inches. A back bulge 4.5 inches high was formed on the rear of the plate. The plate was dished ⅛ inch in the vicinity of the impact. The impact on the surface of the plate covered an area 10.5 inches in diameter. The flaking extended around the impact to a diameter of 16.5 inches. The plate was not cracked, nor was injury done to the backing, bolts or structure.

Third round.—The same gun, 6-inch, was used. The charge of powder was 25 pounds of California S. P. perforated cylinder. The striking velocity was, by chronograph, 2350 foot-seconds and the striking energy 3828 foot-tons. The projectile used was a Carpenter 6-inch armor-piercer without cap, hardened to 2¾ inches below the bourrelet; weight 100 pounds. The impact was at a point 20.25 inches from the bottom of the plate, 21.5 inches from the left edge, 41 inches from the nearest previous impact, and normal to the surface.

The projectile perforated the plate and broke up all parts, going through the plate and the oak backing; but they were stopped by the skin plating without cracking the latter. The hole made in the plate was of an irregular oblong form, having greatest diameter of 8.5 inches at front and rear and no spur. A part of the plate of the same shape as the hole was driven ahead of the projectile in one piece, as though punched by a powerful punch. The plate was dished 0.3 inch in the vicinity of the impact. The flaking on the front face was 17.5 inches in diameter. The plate was not cracked, nor was any further injury done than set forth above to the plate, backing, bolts or structure.

Fourth round.—The same gun, 6-inch, was used. The charge was 32.3 pounds of Dupont's S. P. F. G. 3. The striking velocity was, by chronograph, 1984 foot-seconds and the striking energy 2837 foot-tons. The projectile used was Carpenter 6-inch A. P., fitted with standard cap, hardened to 4 inches below the bourrelet, weight 104 pounds. The impact was at a point 18.25 inches from the bottom of the plate, 9.5 inches from the left edge, 21.25 inches from the nearest previous impact, and normal to the surface. The projectile perforated the plate and broke up, all parts going through the plate, backing and skin plates, and barely entering the sand butt in the immediate rear of the structure. As in the

previous round, the hole made was oblong in shape, with the greatest diameter of 6.75 inches, and practically the same on the front and rear faces. A spur 1.6 inch high was raised about the point of exit. There was no dish in the plate observable about the point of impact. The flaking on the front of the plate was 12 inches in diameter. No other injury than that noted above was done to the plate, bolts, backing or structure. This plate showed great resisting power. The notable features were the extreme toughness of the back of the plate and great thickness of the hard face, the comparatively small flaking on the front face, and the entire absence of coning on exit at the rear. The plate was of good appearance as regards surface, both front and rear.

Continued improvement in quality, peculiar to the American manufacturer, will no doubt result in the near future in armor plate manufactured by this process, and the result will no doubt be equally as superior to that manufactured in Europe as is our present ordinary face-hardened armor.—*Scientific American*, Aug. 27, 1898.

A DEFENCE OF THE TORPEDO-BOAT.

The New York *Times* quotes a naval authority as follows on the value of the torpedo-boat:

"Commodore Hichborn does not seem to think that the torpedo-boat will play much part in future naval warfare. I do not agree with him, and his own article upon the subject affords sufficient ground for this disagreement on my part. He says, after condemning the torpedo-boat and saying that during the war it was practically of no use at all, that 'these boats were not used by either combatant except occasionally for dispatch boats, a duty to which other craft might be more advantageously assigned.' If they were not used properly, I do not see how the Commodore can argue therefrom that the war has disproved their claim to usefulness.

"He also says that the converted yacht Gloucester defeated both the Furor and Pluton, 'among the very best and most modern of the destroyer class.' I don't think that even this result, creditable as it is to our Navy and the gallant men who fought the Gloucester, is at all decisive. There are many things to be considered before we give up these brave little craft, which I am confident are fully equal to the task we have assigned to them.

"We used the torpedo-boats as dispatch boats, and even sent the Winslow into Cardenas harbor to reconnoiter. Such duties should never be given to these craft. Nor should they be subjected to the heavy fire from battle-ships until they are brought under cover to easy striking distance, and then only for the brief period of time in which they are speeding like a bolt toward their victims.

"The Gloucester did defeat the two destroyers at Santiago, but it was under peculiar circumstances. As they came out of the harbor they were fairly swamped by a rain of shell and small shot from the other ships, and besides, they were not protected, but had to make their way toward the foe in an open sea. It would have been a miracle if they had ever got within striking distance of any of our ships.

"The same thing is true of the torpedo-boats that attempted to attack Dewey in Manila Bay. They could not have protection of any kind and

made a bold dash in the open sea at the Olympia. It was in both cases a tempting of Providence and an act of mere bravado or desperation. No careful fighter would have risked these boats in that way, except in such terrible straits that it might be better to go down facing the foe than to surrender or sink his own vessels.

"Great injustice has been done these boats. Although known not to be shot-proof, they have been run into heavy fire. The only result of the war, so far as the torpedo-boat and the torpedo-boat destroyer are concerned, is that we have not yet learned to fight these vessels properly. With all their defensive power sacrificed to speed and the handling of explosives, they had a right to be protected while being advanced to attack. Instead of this, they were pushed forward, fully exposed, to meet certain ruin.

"The lessons we should have learned are: 1, That the torpedo-boats should never be used for making reconnoiters, as we used the Winslow in Cardenas harbor; and, 2, that, when taken into action with battle-ships to attack battle-ships and cruisers of the enemy, they should be kept under the shelter of the big ships. One could go behind each of the great vessels until the proper time came and the proper distance was reached for a dash at the foe. They should then rush out from behind the battle-ship, make a dash for the enemy, discharge their explosives, and return to cover at once. This protection of the weak by the strong was resorted to successfully by Admiral Farragut in his passage of the batteries of Mobile Bay, August 5, 1864. It is the only principle of fighting these small unprotected craft, which must yet be got to close quarters before they can deliver their blow.

"I agree with Commodore Hichborn in the statement that the big battle-ship must still be the main reliance in battle, and that we shall evolve ships that will be greater Oregons, with more speed, greater radius, and greater fighting power; but the torpedo-boat and the destroyer will, I believe, remain as a permanent feature of modern sea fighting. The use of explosives is one of the most striking characteristics of warfare as conducted in the present day. We employed dynamite guns in the field in Cuba, we are using, with fairly good results, a dynamite cruiser, and we are experimenting with boats that will steam under the waves for the sole purpose of exploding torpedoes under battle-ships.

"I consider the torpedo-boat as a step in this line of development. Its small size, its great speed, its inconspicuousness should serve to make it a terrible instrument of destruction. It is admittedly so, provided it can get within range, and it is the duty of the admiral to protect it so with his large boats as to permit it to come up under cover and deliver its fearful thunder right against the side of the great battle-ships. In the midst of a hotly-contested battle I believe it would be a comparatively easy thing for torpedo-boats to rush up to the big men-of-war unnoticed until too late to stop them.

"I notice that in the navies of Europe they are not only building more torpedo craft—both the torpedo-boat and the destroyer—but they are now building a destroyer of the destroyer. This shows how much feared these boats are. It also shows that the development is along lines of speed, connected with destructive power. But we cannot have great speed coupled with great defensive or destructive power, hence we must have the speed of the torpedo-boat for launching great instruments of destruction like torpedoes. In battle and under cover of darkness the torpedo-

boat would be able to inflict the most terrible damage upon a fleet. Of course we cannot fight them against battle-ships in open sea. To do so means that they will be destroyed, as at Manila and Santiago, under a storm of shot and shell from the rapid-fire guns.

"I fancy, too, that had Americans or Japanese or Englishmen been in the Pluton and Furor, and watched their opportunity for mischief, and been bold enough then to carry out their purpose, we should have a different story to write about the result. The Spaniards have never had a victory on the sea."

The American Navy of the future, if the ideas that now prevail in the Navy Department remain in the ascendant, will have an abundance of these small craft. The result at Santiago has not yet destroyed the confidence that naval experts repose in these wasps of the ocean.—*Iron Age.*

VICKERS' QUICK-FIRE FIELD GUN.

On Thursday, July 21st, Messrs. Vickers invited a number of artillery officers and other visitors to witness the performance of their quick-fire field gun at Eynsford. The idea sprang from the recent discussion in the United Service Institution, there being a strong wish to see what could be effected with the latest improvements. The gun discharges a 6-kilo. projectile—being, in fact, a 12-pounder—so that it illustrates what can be done with a full-sized field gun, not the piece of diminished weight that is the natural proposal to avoid the difficulties of recoil. The carriage had placed along under its trail a strong spiral spring and cylinder, terminating beneath the trail eye in a spade with a blade about 8 inches long and 18 inches wide. The front end of the spiral spring connection was attached to the body of the carriage; the cylinder and spade end was held by two chains, one on each side, to a point half-way along the trail. On firing, the carriage ran back, closing the spring, the trail running back over the top of the spade and cylinder end for about 3 feet, when the spring effected the recovery, bringing the carriage forward again. When forced back by recoil the chains become quite loose, and then attachment is not so rigid as to prevent the trail being moved some distance right and left from the true line of the spring and cylinder. The spade after a time had worked a hole in the ground about 1 foot long and 2 feet broad. The ground was good turf and favorable. Judging from the tracks made by the wheels, the right wheel moved smoothly, while for some reason the left wheel jumped to some extent.

We have mentioned the important matter of recoil first, because its control is the essence of the question. It may be seen that 3 feet is sufficient recoil to make the condition very different from those of naval or garrison pieces on fixed mountings. It cannot, indeed, be said that the gun was brought back truly pointed as in the previous round, nor did the layer attempt to keep his eye to the sights. On the other hand, he performed the firing, the lanyard placing him at a sufficient distance to prevent being struck by the recoil. The piece was, however, laid with great rapidity and accuracy, as may be seen from the following figures:

(1) Four rounds of case were fired; the visiting officers from Woolwich took the time, which was 13 $\frac{1}{10}$ seconds. The ammunition was all fixed in metal cartridge cases and fired by percussion.

(2) Eight rounds were fired with common shell and percussion fuses. The time from the first to the last report—that is, the time taken in firing seven rounds—was 44.4 seconds. The target fired at was 22 feet by 12 feet, at 1000 yards' range. On this five out of eight rounds were well planted; one shell was premature and one low.

(3) Six rounds were next fired with shrapnel and time fuses, the fuses having been already set. These were got off in 27 seconds, with excellent effect.

(4) The gun at the visitors' request was now trained 45 degrees off the true direction, and the target sight was run down, and the fuse set at zero, so that every operation had to be performed afresh. One round was got off well in 10½ seconds, making a hit.

(5) Four rounds were next fired with shrapnel, starting with target sight set wrong and gun not laid on the target. In 24 seconds after the word to fire the last round was got off, and all four appeared to give admirable results, all delivering their bullets on the upper half of the target.

For this practice ballistite was used in preference to cordite. The shrapnel shell contains 300 bullets, making up a 15-lb. projectile, and the muzzle velocity is about 1800 foot-seconds. When the fuses were supplied set the gun was worked by two men, with a little assistance from a third. To set the shrapnel fuses an additional man is required. The question is, then, How does the above fulfil the conditions necessary to success in a field quick-firing gun?

It may be seen that there is, as already said, no flinching from a full-sized gun and full weight of projectile. On the other hand, the recoil is not so controlled that the layer was able to keep his eye on the line of sight, and another plan was followed by which the piece was well and quickly laid; but it is to be noted that the conditions were all well known, were favorable, and the layer a man of exceptional skill and activity. It would have been possible for an awkward man to have been injured in attempting what this man did. Again, fixed ammunition with a metal case was used, by which loading and firing are rendered more quick and simple; but this involves the complication and trouble which it is our present effort to avoid. The success achieved was undoubtedly remarkable, however, and shows how much may be effected under favorable circumstances without securing all the special elements which we think desirable. The good effect of the shrapnel especially deserves notice. The weight of gun carriage and forty rounds was 30 cwt.

A mountain gun was afterwards exhibited, firing a 6-kilo. projectile, with a muzzle velocity of about 1000 foot-seconds. The heaviest weight for the mule is 230 lbs. The piece was mounted for action by four men in 47¼ seconds, and dismounted in 28 seconds.

A small 37-mm. piece discharged twenty-three rounds in 5.5 seconds, delivering them on the target without loss of direction.—*The Engineer*, July 29, 1898.

THE EROSION OF GUN TUBES.

*On the Action of the Projectile and of the Explosives on the Tubes of Steel Guns.**

By Professor W. C. ROBERTS-AUSTEN, C. B., D. C. L., F. R. S. (Vice-President).

This important subject has already been discussed by the Iron and Steel Institute. In 1886 the results of some elaborate experiments, conducted by Sir F. Abel and Colonel Maitland† at the Royal Arsenal, led to the conclusion that in a breech-loading gun scoring is produced by the rush of the products of the explosion behind and over the shot, which acts as an air-tight plug passing through the gun. The authors of the paper to which reference has just been made considered that as regards the relative wear of different samples of steel, chemical composition was of far less importance than the mechanical treatment to which the steel had been subjected; and it appeared that the more the steel had been worked and forged, the less it suffered from the effects of the products of the explosion. The average pressure of gas measured in the powder chamber was about 13 tons per square inch, and it was stated that the pressure would be maintained with little diminution during the passage of the shot up to the muzzle of the gun.

All who have conducted experiments with modern artillery know how deeply the rifled bores of guns become scored and eroded during use. It has been stated that the surfaces of the bores of guns also become hardened, even after five "proof" rounds have been fired. An examination of the bores of such eroded guns by the aid of micro-photography should lead to interesting results, and by the kindness of Sir Benjamin Baker the author has been able to obtain a suitable subject for investigation. It consists of a section of the "A" tube of a 4.7-inch quick-firing gun, cut at a point 167 inches from the muzzle. The total thrust between the driving face of the grooves and the driving copper ring of the projectile at this portion of the bore would be about 12 tons. It may be added that, as Sir Andrew Noble has shown,‡ in such a gun as ordinarily employed there would be no less than 60 foot-tons of energy absorbed in producing rotation of the projectile.

The author is also greatly indebted to Lieut.-Colonel C. F. Hadden, R. A., chief inspector of the Ordnance Department at the Royal Arsenal, Woolwich, for a portion of a 3-inch steel armor plate which a "glancing" shot had struck, producing an indentation 0.5 inch deep, 5.1 inches long, partly by compressing the metal and causing it to flow, and partly by tearing portions of metal from the surface of the plate. This indent was produced by an ordinary 6-pounder hardened armor-piercing projectile, and the velocity at the point of impact was 1740 feet per second, and the striking energy would therefore be 126.7 foot-tons.

*Paper read before the Iron and Steel Institute, Stockholm Meeting. His Majesty the King of Sweden and Norway intimated that it was his pleasure to be present during the reading of this paper. Professor Roberts-Austen gave a brief account of the work, and of the researches which had led up to it, dealing only with the main points of the paper itself.

†Journal of the Iron and Steel Institute, No. II., 1886, page 465.

‡Royal Society Proceedings, vol. 1, 1892, page 409.

As regards the action which might be anticipated to occur during the erosion of an "A" tube, the following facts must be remembered: The temperature produced by the explosion of cordite, which was the propellant employed in the case of the tube in question, would be very high. The heat transmitted to the surface of the tube would, however, soon be abstracted by the mass of metal in the gun. This rapid heating of the interior of the tube, followed by more or less rapid chilling by this transmission of the heat, might therefore be expected to occur. Hence there are possibilities of more or less elaborate changes due to the thermal disturbance caused by merely firing the gun. The mechanical effect of the projectile passing along the tube has also to be considered, and the results should prove to be of interest, as the effect of work in producing molecular change in steel has long been a subject of study by Osmond, Barus, Carus Wilson, and others. The explosion produced by cordite would produce in this gun so high a pressure as 15 tons on the square inch. The problem, therefore, becomes a complicated one, which micrographic examination should render it possible to readily elucidate. First as regards the composition of the steel. The tube was a perfectly normal gun-steel, containing about 0.3 per cent. of carbon and 0.6 per cent. of manganese. The respective amounts of sulphur and of phosphorus did not exceed 0.05 per cent., and the amount of silicon was not more than 0.15 per cent. As regards treatment, the tube had been oil-quenched from a temperature of about 800 degrees Cent., and subsequently annealed to about 500 degrees Cent. Examination with any degree of magnification exceeding 100 diameters, of a new tube in which no charge had been fired, should reveal more or less confused pearlite, produced by the annealing, traversed by bands or a network of ferrite. The transition forms of the carbide, troostite of sorbite, might be present, but there should be no martensite. This proves to be the case in all microsections cut from the mass of the tube. If, however, a microsection be taken either from the extreme edge of a "land," or from the driving edge of a groove, a very different structure is revealed. Such examination demands special preparation of the microsection, as only the extreme edge of the "land" is changed, sometimes only to a depth of $\frac{2}{1000}$ inch. It is necessary, therefore, to imbed the metal in a piece of steel of similar carburization and hardness, and to polish the whole. This protects the edge of the metal, which is of interest, from being rounded during polishing, and as the whole of the microsection remains flat, it is possible to focus all parts of it in the same plane. The result of a thorough examination proves that the action of the explosive has, so far as the mass of the tube is concerned, been purely mechanical. The particles of steel have been simply eroded, and there is no evidence of fusion or of the formation of martensite. But at the extreme edge of the "land," or on the driving edge of the groove, both of which have been in direct contact with the driving bands of the projectile, and have been pressed by them, there is an altered layer, often only $\frac{3}{1000}$ inch deep, which has been profoundly altered. The most noteworthy feature is that the ferrite bands seldom pass into this altered layer; they either stop short or fade away as they approach the altered edge. As regards the nature of this band which forms the altered edge, it is difficult to speak with certainty, but in some cases it seems to be a confused mixture of carbides. If the steel had been superficially changed into ordinary hardened steel, the altered layer would, of course, consist of martensite, but the presence of frankly developed martensite could not be detected. This suggests the question whether suffi-

cient time elapsed while the metal was undergoing change for the complete diffusion of the carbon in the layer. So far as is at present known, the formation of martensite would demand this complete diffusion of the carbon. It is even possible that the layer may be a deposited one, composed of the detritus of the eroded matter. Against this view there is the fact that in some cases the ferrite bands fade away as the altered layer is approached. In other cases fine lines of ferrite pass into the altered layer. My friend M. Osmond (of whose counsel I have gladly availed myself) considers that, in a matter of so much importance, it would be unwise to express a definite opinion at present.

I have elsewhere* shown that when a projectile strikes an armor plate it may, under certain conditions, produce in the solid steel a "splash" which resembles that produced by a sphere falling into water. I have also† shown that the penetration or carbon into iron obeys the ordinary law of diffusion of salts into water.

It is noteworthy that the surfaces of the "lands" over which the projectile has passed are traversed by cracks at right angles to the length of the "lands."

With reference to the armor plate struck by a glancing shot, to which reference has been made, I do not find that the micro-structure of the armor plate has been altered by the impact.

The paper was illustrated by a series of micro-photographs, carefully prepared by Mr. W. H. Merrett, and by wall diagrams.

THE RUSSIAN NAVY.

The torpedo-boat destroyer which Messrs. Laird Brothers, of Birkenhead, are to build for the Russian navy is to have a speed of 30 knots, and will resemble those constructed for the British navy. A naval correspondent now in Russia has forwarded some of the details of designs of several of the vessels to be laid down by the Russian government, and these are specially interesting, as our government will require to design ships to beat them. The six 23-knot cruisers will be of 6000 tons displacement, their length being 399 feet 3 inches, their beam 52 feet 10 inches, and their draught of water 20 feet. They will have twin screws, each driven by engines of 9000 indicated horse-power, so that the power will be equal to 3 to 1 ton of displacement, which is exceptionally high for vessels of this size. The radius of action, however, will be low, 5000 miles at 10 knots, and the armament and ammunition will fall far short of our vessels of the same class. There will be two 6-inch guns, twelve 3-inch guns, and six smaller weapons. For commerce destruction these cruisers may be effective, but they will have to run away from the foe; in fact, everything has been forfeited for speed. Russia is also going to have four 25-knot vessels for the same purpose, and here also the armament is insignificant, consisting of six 4.7-inch and six 1.8-inch guns. The vessels will be of 3000 tons displacement, the length being 385 feet, their beam 40 feet, and their draught 16 feet. The horse-power will be 17,000 indicated, equal to over 5½ indicated horse-power per ton of dis-

*British Association, Discourse. Toronto, 1897. The Times, August 23, 1897.
†Journal of the Iron and Steel Institute, No. I., 1896, page 139.

placement. Schichan, of Elbing, is laying down one of these vessels at once, and the four others to be built in Russia may be delayed, so that the experience gained with this vessel may be utilized before the others are actually finished. The vessel to be built by the Vulcan Company of Stettin is to have 6250 tons displacement, and she will have 20,000 indicated horse-power. She has thus more power in reserve than the others. The Germania Company at Kiel, which is practically Krupp's, has also adopted the same size and power as the Stettin firm. Germany has altogether three of the new cruisers and four 27-knot torpedo-boats, the United States one cruiser, and the other cruisers may be built in Russia. The battle-ships have not all been given out, and Britain might secure some share if all goes well in the East, and if the workmen in our shipbuilding yards would be reasonable. It is no new story that thus far British builders have failed only because of the thoughtless attitude of the workers making the Russian government doubtful as to the date of delivery.

The Nevsky shipbuilding yard has received an order for 12 torpedo-boat destroyers, each of about 350 tons displacement, of the type of the Japanese boats built by Yarrow. These works have already in hand ten Sokols, and two more vessels of the same type built at Abo, Finland, are almost ready. The Russian Admiralty has decided to supersede the present Du Temple boilers in all their first-class torpedo-boats by Yarrow boilers. It is also worthy of note that the battle-ship and cruiser ordered by Russia from Messrs. Cramp, of Philadelphia, will have water-tube boilers of the Niklausse type, whereas all the recent ships have Belleville boilers.—*United Service Gazette*, Oct. 1, 1898.

WIRE-WOUND GUNS.

The first wire-wound gun ordered by the United States is expected to be delivered at the proving ground at Sandy Hook, New York harbor, some time during this month. This gun, says a writer in *Cassier's Magazine*, will be of 10 inches bore, 45 calibres in length, and will weigh 30 tons. The contract specifies a normal initial velocity of 2600 feet per second, or 300 feet per second more than that required for any hooped gun now in the United States service. Mr. J. H. Brown, the inventor of this type of gun, is confident that it will stand a charge sufficient to raise the muzzle velocity to 2988 feet per second without material injury to its structure. From official experiments already made at the Sandy Hook proving grounds with an experimental 5-inch Brown gun, this initial velocity appears not only possible, but probable. These tests were made in December, 1893, and again in May, 1896, the first of the trials giving velocities of 3194, 3090 and 3088 feet per second, with average pressures of 65,000, 56,000 and 53,500 pounds per square inch respectively. The difficulty with such velocities seems to lie not so much in the strength of the wire-wound gun as in the erosive action of all powders, though particularly the smokeless variety, on the rifling of the gun when high pressures are unavoidably employed. Lieutenant G. N. Whistler, of the 5th United States Artillery, the engineering expert employed by the trustees of the Brown segmental gun, reports that in the unlined condition of an experimental cylinder, a "slight scoring, following the line of

juncture of the segments, was noticed after a pressure of 43,133 pounds to the square inch. Since the cylinder has been lined, not the slightest scoring of any kind has been observed." As the erosion is most serious, in every description of gun, toward the breech, being caused by the gas of the explosive forcing its way past the gas check of the projectile before the latter has expanded sufficiently to fill the rifled grooves, the Brown segmental guns will have a lining tube inserted part of the way down from the breech, the rifling in the forward end being cut in the bare segments.

Quite recently the United States government is said to have ordered twenty-five 5-inch and twenty-five 6-inch quick-firing guns of the Brown pattern for naval service. These guns will also be forty-five calibres in length, and must stand tests at 2600 feet per second initial velocity. The weight of the 5-inch gun is placed at 7600 pounds; and the weight of the 6-inch at 17,000 pounds. These guns certainly do not show any gain in lightness over British wire-wound guns, which are the only ones now in existence with which to compare them. For example, the standard British Q. F. wire-wound 6-inch gun of forty-five calibres weighs 16,576 pounds, as against the 17,000 pounds of the corresponding Brown gun. Of course, the Brown gun by employing higher velocities may obtain greater muzzle energy, but this may not be practicable for the reason previously given.—*United Service Gazette*, Oct. 8, 1898.

LESSONS FROM THE WAR TO WARSHIP MACHINERY.

The war which has just ended is the first in which modern steam vessels have had a thorough trial, and it seems pertinent, says the report of the Bureau of Steam Engineering, to note the more important lessons which have been taught by our experience. With respect to the machinery they are as follows:

1. The vital necessity of giving the machinery of vessels in reserve frequent tests under working conditions, so that any defects may be discovered and remedied before war makes the vessels' services absolutely necessary. In several cases defects were found after the ships had begun cruising, and the repairs laid them up in the midst of the war.

2. The great importance of having all our naval stations in positions of strategic value properly fitted out for repairs and with adequate supplies of non-perishable stores. It had been evident for a long time that Key West was such a station, but money to put in a proper repair plant was refused year after year and only granted after the war had begun. The movement of large bodies of troops and their equipment almost blocked the railroads, so that after the beginning of the war it was almost impossible to secure the forwarding of tools and supplies.

3. That fresh water for the boilers is almost as important as coal, and that a distilling ship is an important adjunct of a fleet operating away from a base where fresh water can be readily obtained.

4. That every fleet needs a repair ship to enable the efficiency to be maintained without leaving the station, and consequently that several ships should be equipped so as to be ready to proceed with the fleet.

5. The great tactical advantage of water-tube boilers.

6. That if more than two main engines are to be fitted, there should be three engines driving three screws, and not two main engines on each shaft. The New York and Brooklyn had their forward engines disconnected at the time of the Santiago fight and could not stop to couple them. An accident to any part of either of the two engines on a shaft disables half the power; in the three-screw ship this fraction would be only a third.

7. That there should be frequent trials under forced draft to keep the blowers in good condition and to make the men thoroughly familiar with working under maximum conditions. It appears that some of the ships had never been under forced draft since their contract trials until the day of the fight at Santiago.

8. That the location of the forced-draft blowers is a matter of serious importance. In some of our ships, owing to the demand for all other space for other purposes, the blowers had to be located in corners or pockets in the fire-rooms, where it was impossible for human beings to give them proper attention, owing to the intense heat due to lack of ventilation. In the Cincinnati temperatures as high as 205 degrees F. were noted, and the commanding officer, when investigating the case personally, had his face scorched. The blowers must be placed where they can be properly cared for or else they are useless and might as well be left on shore.

9. That the *personnel* of the service should be adequate to the material. It has been notorious for some time that this is not the case, and we are providing for a decided increase in the number of vessels with no increase whatever in the *personnel*. By sending nearly every officer on the active list to sea we were able to give the regular ships a fair complement of trained ones, but had the war been of long duration we should have been greatly embarrassed to supply the places of those disabled or invalided. Volunteers, however well trained in other ways, cannot entirely replace the regular officers.

10. That we must make provision for training the enlisted men of the engineer department. Many of the colliers and auxiliary vessels had to start out with absolutely green crews, many of whom, so far from having the "sea habit," had never been on a vessel of any kind. This must be remedied if our enlarged fleet is to be efficient.

11. That our fighting ships must have the highest practicable speed. There is an almost general agreement on this point among naval men, but if any had thought that this did not apply to battle-ships the fight at Santiago must have shown that the highest practicable speed is just as important in these vessels. It is very gratifying, therefore, that our three new battle-ships are to have speed of at least 18 knots, which is now recognized as the standard.—*The Iron Age.*

THE LARGEST FLOATING DOCK IN THE WORLD.

The great floating dock recently constructed for the Vulcan Company, Stettin, Germany, by Messrs. Swan & Hunter, of Wallsend, Newcastle-on-Tyne, surpasses in capacity the floating dock built by the same firm for the Spanish government and now in operation at Havana. We illustrated the Havana dock in our issue of October 6, 1897, and the remarkable

achievement of towing it successfully across the Atlantic Ocean is fresh in the public mind.

The present dock, like its predecessor, was built from the designs of Messrs. Clark & Stanfield, of Westminster, the well-known dock engineers. It has been constructed with special reference to the lengthening and re-engining of two of the Atlantic liners of the North German Lloyd Company.

The principal dimensions are: Length over all, 510 feet; extreme breadth, 100 feet 9 inches; height from bottom of pontoon to top of walls, 43 feet 7 inches. The internal width is sufficient to allow vessels up to 82 feet beam to be docked, and the depth over the keel blocks is 24 feet. The maximum lifting power is about 12,000 tons.

The dock is what is known as the self-docking type, that is to say, access to all the external surfaces is possible for painting or repairs. Longitudinally it consists of two side walls, between which are connected three pontoons, the centre one being 240 feet long, and the two end pontoons 135 feet. The pumping and controlling machinery consists of eight horizontal centrifugal circulating pumps, placed four in each wall of the dock. These pumps have large vertical shafts, geared by means of bevel wheels and horizontal shafts to two sets of compound engines of 125 horse-power each, which are placed on a deck near the top of the walls. There are four engines in all, and each of them drives two 15-inch centrifugal pumps, the whole machinery being capable of lifting a ship of about 11,000 tons displacement clear of the water in about two and a half hours. The dock is divided into 38 water-tight compartments, each emptied or filled by separate valves. Each engine is supplied by a large, horizontal multitubular marine boiler which is placed in the walls in close proximity to it.

The main line of suction pipes is laid at the bottom of the pontoon walls and runs the entire length of the same. Branches are carried through the walls into the pontoon itself, connection being made by means of flexible joints. The valves for regulating the emptying and filling of the dock, of which there is of course a great number, due to the subdivision of the pontoon, are all manipulated by means of rods and levers from central houses placed one on each wall. From this position also the engines for driving the pumps can be started or stopped at the will of the engineer in charge. The whole of the controlling gear is so arranged that two men, one on each wall, can control the pumping gear of the entire structure.

We have referred to the Stettin dock as being a self-docking structure. It is so named because of the facility with which all parts of the structure can be got at, if desired, for painting, etc. Each pontoon can in turn be detached, lifted, and hung up on the side walls, and while it is in this position any part of it may be examined and repairs, etc., carried out. The underneath portion of the walls, moreover, may be exposed by careening the structure; in fact, any work may be done upon the dock that in any other floating structure would necessitate a visit to a drydock.

In docking a ship, the dock is sunk until the upper floor of the pontoons is well below the level of the ship's bottom. The ship is then floated in between the walls and secured in the desired position. The pumps are then started, and as the buoyancy of the pontoons increases they lift the vessel steadily out of the water.

The advantages of this form of dock are that its first cost is far less than that of a first-class graving dock; it may be moved to any desired

position when the depth of water is sufficient for its operation; it may be built and towed many thousand miles, as in the case of the Havana dock, to its destination, and as compared with the timber docks, it is more reliable and durable.—*Scientific American.*

THE NEW NAVY GUNS.

Designs for a new 6-inch gun, combining the more important features of the Vickers type, the patents for which have recently been secured, are under preparation by the Navy Department, and all new ordnance of this calibre for the naval service will be of this type. The new gun will be almost equal in power to the 8-inch now on ships of the service, and in velocity obtained will far exceed the old ordnance. The important features of the new gun are increased length of tube from forty, the present length, to fifty calibres, which is about that of the 6-inch rifles on the New Orleans, and larger powder chamber. The introduction of smokeless powder has made the increase of velocity possible, and the new gun will have a velocity of not less than 3000 feet per second, exceeding that of the old by from six to eight hundred feet. This will give it an additional penetration of at least two inches more of steel. The weight and cost are increased but little. The Vickers patents enable the Ordnance Bureau to make some important changes in breech mechanism. Sets of forgings for this gun will be purchased shortly, bids having recently been opened from a number of concerns. When delivered these forgings are to be assembled at the gun factory at Washington. At present the gun factory is employed in converting a number of the old 6-inch slow-fire into quick-firing guns, in accordance with the Department's purpose to have all rifles on ship board up to six-inch of the latest type of quick-fire. The new breech mechanism increases the rapidity of fire, besides giving other advantages which make this gun superior in all respects to the old type which is now carried on the Philadelphia and some of the earlier-built ships in the Navy.

Improvements to be made in the larger guns to be manufactured will increase their velocity also. The new 12-inch will have a larger powder chamber and a velocity approximating 3000 feet per second, as compared to 2300 feet, the highest rate now secured. Twelve-inch guns are to take the place of thirteen in all probability on future battle-ships for the Navy, the increased velocities obtainable by the use of smokeless powder rendering this piece more formidable as a weapon than the present 13-inch gun. The lessons of the present war have been few, but important. The importance of length for the smaller type and the superiority of smokeless powder are not exactly novelties, but we have been slow in applying them.—*Army and Navy Journal,* Oct. 15, 1898.

COLT'S NEW MACHINE GUN.

The Colt's Fire-arms Company has, we learn from our American correspondent, brought out a new automatic machine gun, which can be

mounted on a fixed stand or a field carriage, or carried in a long holster by cavalry, or mounted on a police patrol wagon. The gun weighs 40 lbs., the tripod stand 54 lbs. For naval service the weight of a gun mounted on a wheeled carriage with ammunition, etc., is 230 lbs., this design being intended for the use of landing parties. The gun consists of a heavy barrel attached to a casing which contains all the operating mechanism. Towards the muzzle end is a small vent, opening into the barrel, through which the confined gas from the explosion of the powder attempts to escape after the projectile has received its maximum velocity. In so doing the pressure acts upon a small piston which throws an operating lever, causing in turn suitable mechanism to eject the empty shell and place a new cartridge. Springs return the gas lever, which forces the cartridge into the barrel, closes and locks the breech block and cocks the hammer ready to be fired again. If the gun is empty, as in starting, the gas lever is first thrown by hand. When once started, however, the action is entirely automatic, and the gun may be fired singly by pulling the trigger once or continuously by holding the trigger. In the latter case, between 400 and 500 shots can be fired per minute. The handle and trigger are similar to those of a revolver, but there is no guard below the trigger. The cartridges are mounted upon a canvas belt which is coiled up in a box hanging at the side of the gun, so that any movement of the barrel in aiming will not affect the feeding mechanism. The boxes are made in three sizes, containing 100, 250 and 500 cartridges respectively. The gun can be constructed for any kind of rifle ammunition, the standard calibre for the United States navy being 6 mm. or 0.236 inch. Three other standard calibres are also made, 0.7 mm., 0.765 mm. and 0.8 mm. In all cases smokeless powder is required to prevent clogging, and the collection of residue in the barrel is prevented by constructing the hammer to act as a piston for an air pump, which forces a jet of air through the barrel after the empty shell has been ejected. Nickel-jacketed bullets are used, to give the greatest possible penetration, and these give an effective range varying from 1960 feet to 2500 feet, and a penetration of 48 inches to 60 inches of pine, according to the calibre. To avoid accident when a loaded cartridge is left in the barrel, a safety lock is provided, which prevents the hammer from striking the firing pin. The working parts are few, simple and strong, and are so designed that the main spring, firing pin and other parts where there is any possibility of derangement can all be easily and rapidly removed from the rear of the gun without loosening a single screw. The barrel is made unusually heavy, to give weight, prevent injury and obviate the necessity of using the usual water jacket.—*The Engineer*, July 1, 1898.

DAMAGE TO ITALIAN SHIPPING BY GALVANIC ACTION.

An unusual and interesting case has been recently before the Italian courts. The captain of the port of Leghorn, Cavaliere Alcesti Torrini, was the plaintiff in an action against the owners of certain wooden yachts with coppered bottoms lying in the Darsena part of the harbor of Leghorn, to enforce a notice on the owners for the removal of such vessels from that part of the harbor. This notice was made on the grounds that

the new warships and other iron and steel vessels lying in that part of the harbor were damaged by galvanic currents set up from the copper bottoms of the wooden yachts, the contact with the steel vessels being due to ropes which were made fast to different buoys in the harbor or basin. The fact of the damage to steel and iron ships having arisen and of its being due to this cause was clearly established before the court, and the captain's order for the removal of the wooden yachts with coppered bottoms from the Darsena harbor of Leghorn was consequently confirmed by the court.

Prof. Vivian B. Lewes, in a paper read before the Institute of Naval Architects some years ago, stated that damage to shipping was liable to arise from such a cause, and he also put forward the same theory in his book, "Service Chemistry." The fact of the existence of such a danger must be known to very few ship-owners, but it is quite possible that the not infrequent phenomenon of an abnormally rusty bottom of some steel ship might be traced to her having been in galvanic contact with some copper-sheathed wooden vessel.

In commenting upon this case the *Engineer* says that in Italy there is another cause for damage at work, which is not unlikely to manifest itself before long, in so far as several anti-fouling compositions manufactured in Italy rely for their anti-fouling effect solely upon the presence of a very large percentage—30 to 40 per cent.—of metallic copper. Such compositions are applied to the bottoms of a large number of Italian ships, in conjunction with a coat of priming, which is supposed to serve as an insulating medium. However effective powdered copper may be as an anti-fouling medium, our contemporary believes that it cannot be applied with impunity to iron and steel ships. In England anti-fouling paints containing metallic copper are also made, but in no case are they applied to iron or steel ships; they are only used for wooden ships, such as fishing vessels and wooden trawlers, on which they give good results, but manufacturers of composition in this country who supply iron and steel ships have long realized that paints containing metallic copper are absolutely unsuitable for application on steel vessels, a fact on which Prof. Vivian B. Lewes expatiated in his book referred to.

Even if insulated to some extent by a coat of priming paint from the outer surface of the vessel's plates, the presence of 30 to 40 per cent. metallic copper in a paint exposed to the action of salt water must set up a strong galvanic action in the whole structure of the ship, and this cannot fail to exhaust itself on those parts of her structure which are most exposed to corrosion or least protected against it; for instance, the floor plates, tank bearers, tank tops, bunkers, etc., for the galvanic current produced on the outside surface fills the whole metal structure of the ship, and whichever plates are most susceptible to corrosion through exposure or otherwise will be most attacked by it. For reasons of cheapness paints so manufactured have, during the last year or two, been largely used by Italian ship-owners, and have even been applied to several mail and passenger steamers, on which they are undoubtedly a source of great danger to life and property. No doubt Italian ship-owners who have indulged in such false economy will, when passing their vessels through their periodical surveys, pay a bitter penalty for their ignorance and parsimonious practices. In the meantime British ship-owners should be warned against accepting any anti-fouling paints in Italian ports without a guarantee that they are free from metallic copper.—*Iron Age.*

PROPOSALS FOR A FLOATING DRYDOCK.

The Bureau of Yards and Docks, Navy Department, will receive proposals up to October 31 for a floating drydock, the cost not to exceed $200,000, to be located at Algiers, La. The length over all is 525 feet, draft of water over keel blocks 28 feet, width in clear not less than 100 feet. The bidders are to make their own designs. The dock must be capable of lifting a ship of 15,000 tons displacement above the level of the river, and must be proportioned for a battle-ship weighing that much and 450 feet length, and having two-thirds of her weight centered in the middle half of her length. The entire structure must be of steel except the keel blocks, bilge blocks and shores. The power for the operation of the dock may be steam, electric, hydraulic or pneumatic, and may be generated upon shore or upon some permanent structure on the border of the waterfront. Docks designed as single structures must be strong and stiff enough longitudinally to safely distribute the load over the entire length of the dock if the vessel be docked in one end thereof. Designs for sectional docks must make adequate provision for connecting the sections so that the dock may act as a unit and the sections be kept level and in line without straining the ship, so that in case one of the sections should lose all its buoyancy the connections of the sections shall be capable of distributing over the remaining sections the weight of the injured section and all the parts of the ship over the whole.—*Iron Age.*

A NEW METHOD OF MAKING HARD-FACED ARMOR.

Taking advantage of the fact that by suitably controlling the process of cooling it is possible to obtain some of the newer alloys of iron with nickel, cobalt and manganese in either a hard or a malleable condition, M. Jean Werth, manager of the Société Anonyme des Hauts Fourneaux et Aciéries de Denain et Anzin, has devised a new process of making armor plate. M. Werth's contention is that the plate should have the same chemical composition throughout, and that the hard face should be obtained entirely by a process of tempering. Ordinary carbon steel in large masses cannot be tempered satisfactorily, but when alloyed with suitable proportions of nickel, cobalt or manganese it is possible to obtain the metal in a hard state by heating it up to a bright red and allowing it to cool in the air; whereas, if heated only to a dull red and cooled, the metal will be malleable and comparatively soft. The steel used by M. Werth is open-hearth metal, free from sulphur and phosphorus. It contains from 5 to 15 per cent. of nickel or cobalt, and from 2 to 12 per cent. of manganese; while within certain limits silicon, chromium or tungsten may be present without interfering with the process of tempering. In its soft state such a steel has a tensile strength of 110,000 to 140,000 pounds per square inch, and a strip 1¼ inches thick can be bent without cracking round a radius equal to its thickness. After the plate is completed it is tempered by making it part of the side or bottom of a furnace. The face next the fire thus becomes heated to a bright red, while by means of water or air the temperature of the back face is kept down to 800 or 900 degrees F. To insure good results the heating is effected very gradually, the plate being put into a cold furnace;

and by preference gas fuel is employed in the latter. Another method of effecting the heating, which is, however, only applicable to flat plates, is to immerse their front faces in a bath of red-hot lead, the temperature of which is maintained very uniform. When ready the plate is removed from the furnace and cooled at the back, until the front face has sunk down to a temperature of 800 to 900 degrees F., when no further attention is required, though if warped it can now be straightened before the cooling is finished.—*Iron Age.*

CONTRABAND OF WAR.

WASHINGTON, D. C., June 28, 1898.—The Navy Department, in conjunction with the State Department, has issued a long expected order defining contraband of war, which is embraced in a series of "Instructions to blockading vessels and cruisers." These instructions embrace many matters of only special interest to the commanders of vessels blockading Spanish ports, but the provisions relating to contraband of war are contained in the following sections:

"The term contraband of war comprehends only articles having a belligerent destination, as to an enemy's port or fleet. With this explanation the following articles are, for the present, to be treated as contraband:

"*Absolutely Contraband.*—Ordnance, machine guns, and their appliances, and the parts thereof; armor plate, and whatever pertains to the offensive and defensive armament of naval vessels; arms and instruments of arms, steel, brass or copper, or of any other material, such arms and instruments being specially adapted for use in war by land or sea; torpedoes and their appurtenances; cases of mines, of whatever material; engineering and transport materials, such as gun carriages, caissons, cartridge boxes, campaigning forges, canteens, pontoons; ordnance stores, portable range-finders, signal flags destined for naval use, ammunition and explosives of all kinds; machinery for the manufacture of arms and munitions of war; saltpeter; military accoutrements and equipments of all sorts; horses.

"*Conditionally Contraband.*—Coal, when destined for a naval station, a port of call, or a ship or ships of the enemy; materials for the construction of railways or telegraphs, and money, when such materials or money are destined for the enemy's forces; provisions, when destined for an enemy's ship or ships, or for a place that is besieged."

It will be seen that the list of contraband articles is restricted to those plainly intended for use in war, and does not embrace raw material unless its ultimate use for the purpose of carrying on war is clearly evident. Thus, there is no embargo upon ores, metals, tools, machinery, etc., except as clearly defined in the section quoted when intended for the manufacture of appliances or munitions of war.—W. L. C.

THE RADDATZ SUBMARINE BOAT.

A Milwaukee press dispatch states that on the 21st inst. a public test of the Raddatz submarine boat was made in the presence of a large

party, which included a number of engineering experts, among whom were Superintendent Reynolds of the E. P. Allis Works and City Engineer Benzenberg. The test was continued for several hours. Mr. Raddatz and his engineer went down in the boat, and after a short delay caused by a foul anchor the boat dropped out of sight and remained under water cruising around for half an hour, its presence under the water being indicated by a float of wood, which was made fast to the turret. Mr. Raddatz then brought the boat to the surface with the body just under the water and took short runs around the bay.

Once more he disappeared and remained down this time for 20 minutes and again came to the surface, and threw off the top of the turret.

The boat drops gradually and on a level keel and comes up the same way. The disappearance under water and the reappearance on the surface are apparently regulated by the water ballast, as the boat is so sensitive that any extra weight inside renders it necessary for the inventor to readjust his apparatus. The air is supplied by chemicals, which are contained in a box that is securely locked. These chemicals furnish air enough, the inventor says, to supply one man under the water for 24 hours.

The boat is operated under some difficulties, as she is not large enough to install the power that is necessary. It is probable that a new boat will be built having a diameter of 7 feet instead of 4, which is the diameter of the present boat.—*Iron Age.*

A NEW QUICK-FIRE NAVAL GUN.

British naval ordnance experts have developed a gun which for rapidity of fire is said to excel any of its type and class so far known. The rifle is of 6-inch calibre, wire wound and capable of tremendous penetration, velocity and quickness of fire. Reports of experiments recently conducted with it at Portsmouth, England, received by the Naval Intelligence Office at Washington, show that the piece weighs only a little more than 7 tons and is far lighter and stronger than the old type. Compared with the old pattern 6-inch rifles such as are now mounted on the Philadelphia and some of the first ships of the navy, one of the new guns is equal in effectiveness to two of them on account of the improved breech mechanism, which admits of remarkable rapidity of firing. A single motion opens and closes the breech. An automatic attachment is fitted for working the primer so that when the breech is closed a slide automatically covers the tube until the plug is locked, and when the plug is opened the empty primer is automatically ejected.

In the recent trials a velocity was obtained of 2780 feet a second, the pressure being 15.9 tons. The striking energy was 5374 foot-tons, as compared with the 3356 foot-tons for the ordinary gun. Aiming at a target 3000 yards away, the gun was fired at a rate of one round in ten seconds. In all 110 rounds were fired, the breech mechanism working quickly and easily in every case. The large and heavy metallic cartridge cases have been done away with, effecting a saving in weight and space in the magazines, simplifying the operations of loading and rendering unnecessary a cartridge case ejector in the breech mechanism.

Another trial of the gun and mount took place later for the purpose

of testing the accuracy of the gun after 200 rounds had been fired from it, and to submit it to a test for rapidity of fire under service conditions. In the accuracy test ten shots were fired and the gun showed no deterioration in that respect, in spite of the large number of rounds previously fired. The test for rapidity was made with a crew of trained seamen in charge of an officer from the gunnery ship Excellent. Thirty-six rounds were fired in 4 minutes and 47 seconds, including the time lost in taking temperatures of the breech-plug head, making the rate of fire one shot in 8 seconds approximately.—*Iron Age.*

A Parliamentary paper was issued in July containing a return showing the fleets of Great Britain, France, Russia, Germany, Italy, the United States of America and Japan, distinguishing the various types of vessels built and building. The return shows the date of launch, displacement and armaments reduced to one common scale. It will be observed that this year the return includes for the first time the fleet of Japan. The last time the return was issued was in November, 1896. Vessels which appeared on March 31st, 1898, in the official list of each navy as built or building are enumerated, including under the latter head those for which on that date money had been appropriated and which were shortly to be laid down. The following tables exhibit the total number of vessels in each class belonging to each nation:

VESSELS BUILT.

	Great Britain.	France.	Russia.	Germany.	Italy.	United States.	Japan.
Battle-ships	52	27	12	17	15	5	3
Cruisers, armored	18	9	10	3	3	2	1
" protected	95	30	3	7	15	14	10
" unprotected	16	16	3	21	1	10	8
Coast-defense vessels, armored.	15	14	15	11	..	20	3
Special vessels	3	1	5	1	2	1	..
Torpedo vessels	35	13	17	2	15	..	1
Torpedo-boat destroyers	50	..	1	..	..	..	..
Torpedo-boats	98	211	174	113	142	8	44

VESSELS BUILDING.

Battle-ships	12	8	6	5	2	8	3
Cruisers, armored	8	10	1	2	2	..	6
" protected	24	10	3	8	3	1	6
" unprotected	..	..	..	..	..	..	1
Coast-defense vessels, armored.	..	..	1	..	..	..	..
Special vessels	..	..	..	..	..	..	..
Torpedo vessels	..	2	..	..	..	..	..
Torpedo-boat destroyers	46	8	28	1	1	20	8
Torpedo-boats	..	38	..	9	2	22	12

The return is, to a certain extent, misleading, as there is no attempt at classification, a third-class battle-ship like the Neptune, for instance, being placed in the same list with the Majestic; while the supplemental pro-

gramme proposed by Mr. Goschen in July, and approved by the House of Commons, adding 4 battle-ships, 4 cruisers and 12 torpedo-boat destroyers to the building programme, is of course not included.

In the subjoined table we give the number of ships of the principal classes built, building and proposed to be laid down during the present financial year (our own supplemental programme being included) compared with those of France and Russia:

First-class battle-ships—	Built.	Building and to be laid down.	Total.
Great Britain	29	16	45
France	15	5	20
Russia	7	11	18

Great Britain has therefore 45 first-class battle-ships built, building and to be laid down, as against 38 for France and Russia.

Second-class battle-ships—	Built.	Building and to be laid down.	Total.
Great Britain	10	0	10
France	10	1	11
Russia	6	0	6

Great Britain has therefore 10 second-class battle-ships as against 17 of France and Russia.

First-class armored cruisers (effective)—	Built.	Building and to be laid down.	Total.
Great Britain	9	12	21
France	6	10	16
Russia	6	4	10

Giving Great Britain 21 to 26 of France and Russia of this class.

First-class protected cruisers—	Built.	Building.	Total.
Great Britain	13	8	21
France	4	4	8
Russia	0	0	0

Giving Great Britain 21 to 8 of France and Russia of this class.

Second-class cruisers—	Built.	Building.	Total.
Great Britain	49	5	54
France	16	2	18
Russia	3	6	9

Giving Great Britain 54 to 27 of France and Russia of this class.

Third-class cruisers—	Built.	Building.	Total.
Great Britain	36	10	46
France.....	10	3	13
Russia	13	0	13

Giving Great Britain 46 to 26 of France and Russia, and a grand total of cruisers of all classes of 142 to 87 of France and Russia.

Torpedo-boat destroyers—	Built.	Building.	Total.
Great Britain	81	27	109
France	0	8	8
Russia	1	28	29

Giving Great Britain 109 torpedo-boat destroyers as against 37 of France and Russia.—*Journal of the Royal United Service Institution.*

THE INCREASE IN THE WORLD'S PRINCIPAL NAVIES.

Among the late reports of the Office of Naval Intelligence, in the U. S. Navy Department, is one by Lieut.-Commander W. H. Driggs, U. S. N., on "The Increase in Naval Strength" of England, France, Germany, Russia and Japan. At a time when additions to our own Navy are being looked upon with especial favor it is interesting to note what other nations are doing in this direction, and for this reason we make a brief abstract of the paper of Lieut.-Commander Driggs.

England, as always in naval matters, is far in the lead. The budget voted for 1897-98 amounts to about $107,000,000, providing for an expansion in all branches of the navy. The number of officers and men has been increased from 88,850 in 1895 to 100,050 in 1897, including in these figures the coast guard. The total of ships under construction and to be built during the fiscal year of 1897-98 is 108, including 14 battle-ships, 8 first-class cruisers, 9 second-class cruisers, 10 third-class cruisers and 52 torpedo-boat destroyers.

Russia is not only adding to her naval strength, but is also actively engaged in opening up harbors and channels for strategical purposes and establishing naval bases in foreign countries. The naval programme that was mapped out in 1896 involves an expenditure of $318,000,000, though the exact number of ships contemplated is not specified by Lieut.-Commander Driggs.

France in her budget for 1898 asks for $55,108,000 for naval purposes, allotting nearly $20,000,000 of this for new ships. Her present building programme extends over a period of eight years, and involves an expenditure of about $144,300,000. Like Russia, she is providing for better harbors and channels at home, and is creating bases for supply and repair in foreign waters. Admiral Besnard, the French Minister of Marine, calls especial attention to the need of fast cruisers in modern naval warfare, and to emphasize his demand for additional ships of that class in the French navy he presents two tables showing certain naval conditions in May, 1897, as follows:

AVAILABLE.	England.	Triple Alliance.	Russia	France.
First-class cruisers	24	3	5	8
Second-class cruisers	61	26	7	12
Dispatch boats	50	19	20	13
Torpedo-boats and torpedo-boat destroyers	51	38	9	13
Total	195	86	41	46
UNDER CONSTRUCTION.				
First-class cruisers	12	10	6	5
Second-class cruisers	6	3	1	7
Dispatch boats	10	5	0	1
Torpedo-boats and torpedo-boat destroyers	14	1	1	3
Total	42	19	8	16

In addition to the above France had in 1897 10 battle-ships and 7 armored cruisers under construction, and, counting all classes, she had 63 warships under construction in that year.

Germany in now putting into execution a naval programme laid down in 1873 and deferred until the present time for lack of funds. This programme calls for an active fleet of 17 battle-ships, 8 armored coast-defense ships, 9 large cruisers and 26 small cruisers. In addition, she proposes a reserve fleet of 2 battle-ships, 3 large cruisers and 4 small cruisers. The total proposed and those classed as available by the German government are shown in the following table:

	Total authorized.	Available.
Battle-ships	19	12
Armored coast-defense	8	8
Large cruisers	12	10
Small cruisers	30	23

Germany recognizes the fact that to maintain a modern fleet she must provide for the replacement of old-type ships. To this end she fixes the period of efficiency of battle-ships and armored coast-defense ships at 25 years, of large cruisers at 20 years and of small cruisers at 15 years; after these periods of service they would have to be replaced by others of the newest type. The *personnel* of the German navy is to be raised from 18,138, its present strength, to 26,637 in 1904.

Japan has a naval programme to be completed in 1906, and during this period she proposes to spend $192,396,546. This programme calls for the addition to her navy of the following vessels: 4 battle-ships of 15,000 tons, 4 armored cruisers of 9500 tons, 3 second-class protected cruisers of 4800 tons, 2 third-class protected cruisers of 3200 tons, 3 torpedo gunboats of 1200 tons, 11 torpedo-boat destroyers and 89 torpedo-boats. Prior to her war with China, Japan only had 18 cruisers ranging from 1500 to 4000 tons. When those authorized are completed she will have a navy of 65 ships of war, 11 torpedo-boat destroyers and 115 torpedo-boats. Japan now has 1725 officers in her navy exclusive of midshipmen and sub-lieutenants.

In the above lists the total proposed expenditure for naval purposes, according to adopted programmes, amounts to $1,001,690,000, all to be expended before 1906 by five nations only.—*Engineering News and American Railway Journal.*

According to a report issued by the Ministry of Marine, the officers' list of the Imperial German navy is constituted as follows: The Secretary of State for the Navy, 2 admirals, 3 vice-admirals, 9 rear-admirals, 47 captains, 82 commanders, 220 lieutenant-commanders, 254 lieutenants, 173 sub-lieutenants, 1 colonel and 39 officers of marine infantry, 115 engineers, 132 surgeons, 39 torpedo officers and engineers, 55 ordnance officers, 96 paymasters, and 25 pensioned officers, making a total of 1299 officers of all ranks, in addition to whom there are 267 midshipmen and naval cadets. The *personnel* of the men consists of 979 warrant officers, 4382 petty officers, 16,679 seamen, 659 bandsmen and artificers, etc., and 750 boys including their instructors, making a grand total of 23,449 men. The men are divided as follows: Two seamen's divisions, each with two subdivisions and one subdivision of boys, 10,722 men; two dockyard divisions

of five companies each, 6305 men; two torpedo subdivisions, 2563 men; four seamen-gunner subdivisions, 2202 men; two marine battalions of four companies each, 1201 men; the gunnery staff, 110 men; torpedo and submarine mining staff, 165 men; surveying staff, 14 men; and clothing department, 167 men; making a total as given above of 23,449 men.—*Royal United Service.*

THE NEW BATTLE-SHIPS.

WASHINGTON, D. C., September 6, 1898.—The anticipation of the Navy Department experts, who have predicted that the contractors proposing to build the battle-ships Nos. 10, 11 and 12 would be able to guarantee the highest speed yet secured in an American vessel of this class, were realized when the bids for these vessels were opened on the 1st inst. At this writing it seems altogether probable that the Government will award one vessel each to the firm of Wm. Cramp Sons of Philadelphia, the Union Iron Works of San Francisco, and the Newport News Ship Building and Dry Dock Company. This result is especially gratifying in view of the fact that the Department's original plans provided only for the construction of vessels capable of making 16 knots. These plans were opposed with much vigor by Chief Engineer Melville, who insisted that for the amount available vessels of 18 and 19 knots could be constructed having greater radius of action and an adequate coal capacity. Chief Melville's representations were urged upon the Department with so much energy that an informal notice was finally sent to all probable bidders to the effect that, other things being equal, speed would be an important consideration in the awarding of contracts. The builders promptly responded to this suggestion, and it is exceedingly gratifying to the Department to know that all of the vessels to be contracted for will have a speed at least 2 knots higher than the original specifications called for. Following is the official summary of the bids opened:

J. H. Dialogue & Co., of Camden, N. J.—One ship on Department's plans, speed 16 knots, delivered in 33 months, price $2,840,000.

Newport News Ship Building Company—One ship on Department's plans, speed 16 knots, delivered in 31 months, price $2,580,000; one ship on contractors' plans, speed 17 knots, delivered in 32 months, price $2,680,000; one ship of 12,850 tons on Department's plans modified by details of Bureau of Steam Engineering, speed 18 knots, delivered in 32 months, price $2,880,000.

Wm. Cramp Ship Building Company, Philadelphia—One ship on Department's original plans, speed 16 knots, delivered in 29 months, price $2,650,000; two ships of the same class for $2,625,000 each; one ship of 11,500 tons on contractors' plans, speed 17 knots, delivered in 32 months, price $2,725,000, or two of the same class for $2,700,000 each; and one ship of 12,150 tons on contractors' plans with modified details of Bureau of Steam Engineering, delivered in 32 months, price $2,885,000, or two of the same class for $2,870,000 each.

Union Iron Works of San Francisco—One ship on Department's original plans, speed 16 knots, delivered in 31 months, price $2,674,000; one ship on contractors' plans, speed 17 knots, delivered in 31 months, price $2,725,000; one ship of 12,200 tons on contractors' plans with modified

details of Bureau of Steam Engineering, speed 18 knots, delivered in 33 months, price $2,899,000.

Although three of the contractors offered to build battle-ships of 18 knots speed, all their bids ranged under the maximum price fixed by Congress in the last annual appropriation bill authorizing these vessels, and the Department, therefore, need only consider the proposals for the highest rate of speed. As the Department is always anxious to distribute its contracts as widely as possible among responsible bidders in order to secure the earliest possible delivery, and also to keep the maximum number of shipbuilders in the field for Government work, the officials were much gratified to find that, while the bid of the Union Iron Works was the highest submitted, yet it does not exceed by over 4 per cent. (the limit fixed by law as a concession to Pacific Coast builders) the bid of the Cramps, hence one of the vessels may be awarded to the company who have added so much to their reputation by the wonderful performances of the Oregon in the late war. As the Newport News Ship Building Company only bid on one vessel, leaving the competition for the other two between the Union Iron Works and the Cramp Company, the 4 per cent. provision comes in opportunely to enable the Department to award one vessel to each firm. There is a possible, though not a probable, contingency that the proposition of the Newport News Company may be rejected because of the unwillingness of the Department to adopt the plan submitted, which is original with them, although incorporating certain of the high speed suggestions of the Bureau of Steam Engineering. In case this design is disapproved the Cramp Company will probably be awarded contracts for two vessels.

The new battle-ships will be at least 1000 tons larger than the Illinois class, upon which the original specifications were based. In the original design the general characteristics were stated as follows: Length at normal displacement, 368 feet; molded breadth at water-line, 72 feet; mean draft at normal displacement, 22.5 feet; normal displacement, 11,500 tons; coal capacity, loose stowage, 1200 tons. The Cramp design involves the lengthening of the ships about 15 feet, which gives sufficient room for the introduction of machinery with Niclausse water-tube boilers for a speed of 18 knots. It is also believed that greater coal capacity will be developed, and should it prove practicable to decrease the thickness of the armor plates, as a result of the test of Krupp plates now in progress, a very material increase in steaming radius would be secured.

The Newport News Company also propose to lengthen the Department's designs nearly 20 feet, increasing the displacement to about 12,500 tons. Cylindrical boilers will be used with Powden forced draft.

The Union Iron Works adopted the suggestion of the Bureau of Steam Engineering as to the lengthening of the hull, and will employ Ward water-tube boilers, which they originally placed in the coast-defense vessel Monterey, which was built by this firm at San Francisco in 1890. These boilers have given excellent satisfaction, the reports showing economy of fuel in addition to ability to get up steam in the shortest possible space of time. The experience of Admiral Sampson's fleet in destroying the Spanish squadron off Santiago has demonstrated the importance of being able to make steam rapidly from cold water, and the water-tube boiler, which has been strongly advocated for battle-ships by Chief Engineer Melville for more than a decade, has received a decided impetus.—*Iron Age.*

SHIPS OF WAR.

[ARGENTINE.]

THE ARGENTINE CRUISER GENERAL SAN MARTIN.

This vessel was constructed and completely finished by Messrs. Orlando Brothers in their dockyard at Leghorn. Her principal dimensions are as follow: Length between perpendiculars, 100 metres (328 feet); beam, 18.71 metres (61 feet 10 inches); depth moulded, 12.19 metres (40 feet); mean normal draught, 7.10 metres (23 feet 3½ inches); displacement, 6882 tons. The hull is of Siemens-Martin steel with a double cellular bottom, divided by numerous water-tight compartments and by numerous water-tight transverse bulkheads into fifteen main water-tight compartments.

The protection consists of an armored belt 2.75 metres (9 feet) in depth, of a maximum thickness of 150 millimetres (5.90 inches), extending right fore and aft, and 6 feet below the load water-line. In the central part of the ship this side armor is increased up to the upper deck, forming a redoubt which is closed in at the two ends by armored bulkheads 120 millimetres (4.72 inches) in thickness, and extending from the lower to the upper deck. The turrets of the large guns are within the redoubt thus formed, as well as the broadside quick-firers. An armored deck of turtle-back form, and of the mean thickness of 37 millimetres (1.46 inches), runs from stem to stern. The upper deck, within the redoubt, is also covered with a plate 40 millimetres (1.58 inch) thick, while the lower deck outside the redoubt has one plate 20 millimetres (0.79 inch) thick. For the length of the engine and boiler-rooms the double-bottom construction extends up the side of the ship to the underside of the armored deck, and from this point to the gun deck there is a cofferdam at each side. The nickel-steel plates used for armor were manufactured by the Società degli Alti Forni Fonderie e Acciaierie at Terni, with a special process of cementation similar to Harvey's.

The armament of the General San Martin is as follows: Four guns of 203 millimetres (8 inches) calibre, situated in pairs on two revolving armored turrets, 102 millimetres (4 inches) thick, at the end of the redoubt, with the very wide angle of training of 274 degrees; ten guns of 152 millimetres (6 inches) arranged in battery on the redoubt, with an arc of 110 degrees, the fore and aft guns being able to fire in the line of keel; six guns 120 millimetres (4 feet 7 inches) on the upper deck, the central weapons having an arc of 130 degrees, the bow and stern guns 155 degrees, and firing in the line of keel. Twelve guns of 57 millimetres, ten Maxim machine guns of 37 millimetres, two landing guns 75 millimetres, two landing mitralleuses of rifle calibre, and four torpedo tubes on the broadside on the lower deck for discharging 18-inch torpedoes. Most of the artillery was furnished by Messrs. Armstrong, of Pozzuoli, and is all according to the latest models, wire construction, single movement pedestal mounting with quick double electric or percussion firing. Whitehead, of Fiume, furnished the torpedo-launching tubes for firing with cordite.

The magazines are very large, the various kinds of projectiles and charges and cartridges being arranged in separate rooms. The ammunition service, studied by Messrs. Orlando with the greatest care, together

with the arrangement and distribution of the projectiles, is performed by 16 vertical and inclined elevators of a special type, constructed according to the designs of Messrs. Orlando, and furnished, along with their hand and electric motors, by the Società Nazionale delle Officine di Savigliano, of Turin.

Electric motors for the service of the turrets, combined with hand and speed-regulating gears, insures rapidity in working and instant stopping.

The crew consists of 500 men and 40 officers. The admiral's apartment includes a stateroom and a dining-room. The officers' messroom is in carved wood and inlaid in the Italian style. The ventilation of all the rooms is by a distribution of ventilating tubes and other mechanical apparatus.

The electric plant for illumination and transmission of energy for the service of the artillery and projectors consists of five compound-wound dynamos of 300 amperes and 80 volts, coupled to vertical compound tandem engines furnished by Franco Tosi, of Legnano. Two are arranged over and two under the armored deck. The dynamos are interchangeable. There are 700 lamps and four reflectors of 16 lamps for overboard illumination during coaling; five projectors of Schuckert's type with parabolic mirrors arranged as follows: One on the mast of 750 millimetres (29.5 inches) with 360 degrees range of view; four of 600 millimetres (23.62 inches) in the battery with 180 degrees range. The foretop searchlight is to be operated from a distance by electric motors.

The propelling machinery, furnished by the Società Industriale Napoletana Hawthorn Guppy, of Naples, consists of two sets of triple-expansion vertical engines with three inverted cylinders of 1.04 metres (42 inches), 1.610 metres (63.38 inches), and 2.360 metres (82.91 inches) diameter and 1.17 metres (46 inches) stroke. The high-pressure cylinder has a piston valve, the others ordinary slide valves, and Joy's assistant cylinders. The cylinders are all steam-jacketed. The slide motion is with double bar links on the Stephenson system, and the starting motion includes steam and hand independent apparatus. The two main condensers, of gun metal, have a cooling surface of 16,000 square feet. The circulation water is provided by two centrifugal pumps of 1.22 metres (48 inches) diameter, driven by independent compound engines. They have each of them an auxiliary air pump. The two single-acting main air pumps, with cylinders 686 millimetres (27 inches) in diameter by 533 millimetres (21.78 inches) stroke, are driven by side levers from the intermediate cylinder crosshead. Two main Worthington feed pumps draw from hot wells or from the compartments of the double bottom fitted as fresh water tanks. Two centrifugal ventilators of 1.22 metres (48 inches) diameter are fitted for ventilating the engine-rooms.

The two propellers are of gun-metal, each with four blades, and have a diameter of 4.876 metres (16 feet) and a pitch of 7.190 metres (23 feet 7 inches).

Steam is provided by two groups of four boilers situated abaft and forward of the engines. The communication is through a tunnel fitted with water-tight doors. As in the engine compartment, there is a centre line longitudinal water-tight bulkhead, so that each pair of boilers are in a separate compartment. All the boilers are single-ended, the four forward boilers and the first two abaft the engines having a diameter of 4.74 metres (15 feet 6½ inches) with four Fox's furnaces 1.019 metres (39 inches) diameter. The total grate surface is 72 square metres (775

square feet), and the heating surface 1997 square metres (21,427 square feet). The steam pressure is 155 lbs. to the square inch. For the forced draught every boiler is provided with an under-grate blowing centrifugal ventilator, while steam elevators and hydraulic ejectors perform the ash service. The two funnels have a diameter of 2.438 metres (8 feet), with a height of 22.90 metres (75 feet) from the grate level.

Four Worthington auxiliary feed pumps of 127 millimetres (4.99 inches) diameter are placed in the boiler-rooms, and two of similar size for the bilge, and two of 178 millimetres (7 inches) diameter for the fire service.

There is an auxiliary boiler, 2.43 metres (8 feet) in diameter, arranged on the armored deck; it has two furnaces with a grate surface of 25 square feet, while it has a heating surface of 629 square feet, and works at 155 lbs. pressure.

The bunkers are arranged on and beneath the armored deck, and have a respective capacity of 673.2 and 638.4 metres, in all 1311.66 metres (about 46,300 cubic feet).

Amongst the auxiliary machinery on board is a 380-millimetre (15-inch) Worthington steam exhaust pump, two Yaryon distillers, each with a capacity of 30 tons of water per 24 hours; several Dawton service and fire pumps; a vertical double-cylinder engine, 300 millimetres (11.18 inches) in diameter, for the anchor service, acting independently; three large windlass heads and a central capstan; a double independent service of steam-steering engines, arranged under the armored deck in two compartments, a two-cylinder mooring winch with 228-millimetre (9-inch) cylinders, and a large workshop for repairs, the machinery being driven by electric engines. We may also note the landing gear for 152-millimetre guns, those for the torpedo manœuvring, the electric gear for transmission of the orders to the artillery, the electric gear (Molinari's system), showing the engine revolutions, all of them arranged on the conning bridge and in the armored turret.

The General San Martin has 10 boats, of which two are steam cutters and four lifeboats, all to be worked by steam derricks and davits. There is a mooring winch provided with suitable drums for wire cable. All the gear was submitted by Messrs. Orlando to severe tests, under the survey of a commission of Argentine officers presided over by the Commander Sir Manuel José Garcia, and before by the Comodoro Martin Rivadavia, who signed the contract of this ship.

The trials of the artillery took place on February 2, 3, 4 and 5 at Spezia, under the control of the Royal Italian navy, and with the assistance of Argentine officers, and the results proved most satisfactory. Neither the ship nor the inside fittings underwent the slightest damage during the firing of the powerful artillery, and the solidity of the construction, as well as the great military value of the ship, was thereby well tested. Equally satisfactory proved the trials of illumination, of the firing of torpedoes, and the working of the projectors, as well as those of the electric firing of the guns, which executed a simultaneous firing of eight guns, say five guns of 152 millimetres and three guns of 120 millimetres from the same side, without causing the least damage to any part of the ship.

Three speed and engine trials were carried out under the direction of the naval architects and mechanical engineers, Messrs. Giuseppe and Salvatore Orlando, as representatives of their firm, and of Mr. Fowley, representing the firm Hawthorn Guppy. The ship was entrusted to

Commander Cap. Chiodo, under the control of the Argentine Commission, presided over by Commander Manuel José Garcia, who, owing to the excellent results obtained, considered these three preliminary trials as definite and conclusive.

The first six hours' natural-draught trial took place on February 8, on the following course, viz. Scoglio Ferale-Torre Guardiola, 2.20 nautical miles of the beautiful Gulf of Spezia. The medium draught of the ship was 7.155 metres, somewhat in excess of the normal.

The sea was "agitated," there being a strong north wind blowing. The result was as follows, viz.: Mean speed, 18.071 knots; maximum speed, 18.439 knots; mean revolutions, 93.87; maximum revolutions, 95.5; mean indicated horse-power, 8285.8; maximum indicated horse-power, 8832; slip of propeller, 17 per cent.; coal consumption per indicated horse-power, 0.083 kg. (1.77 lbs.); mean pressure in the boilers, 144.2 lbs.; mean pressure at the valve chests, 139.86 lbs.

The second trial at progressive speeds, from 10 to 18 knots, took place on the course Scuola-Tino (1.005 nautical miles), off the Gulf of Spezia, on February 16, and served to trace the real speed curve and to ascertain the slip of the screws. The mean draught of 7.131 metres was also in that instance in excess of the normal one, while a slight west-southwest wind kept the sea rather rough. The depth of water, which is shallow, evidently influenced the speed adversely. The results obtained were from 10.021 knots up to 18.17 knots; 48.3 revolutions up to 92.84 revolutions; 1124.47 I. H. P. up to 8285 indicated horse-power; slip, 10 to 17 per cent.

In the two hours' forced-draught trial of March 22 on the original course of 2.2 miles—with a mean draught of 7.12 metres—the mean speed of 19.68 knots and the maximum speed of 20.06 knots was obtained with 104 revolutions and 12,436.5 indicated horse-power. The air pressure was on the average 25.6 millimetres (1 inch) of water, while the contract permitted 40 millimetres (1.6 inch). Not the slightest damage occurred either to the engines or the boilers, which maintained the almost constant pressure of 148 lbs. It is noteworthy that during the trial the regulating valve maintained the same opening, and that among the steam jackets only the high-pressure one was supplied with steam. There was no serious vibration, and all went on, as in the preceding trials, with the greatest regularity. In consequence of such good results, the Argentine Commission expressed to Messrs. Orlando their highest satisfaction. The designs of the hull are by Mr. Masdea, inspector of the Royal Italian navy. The modifications relating to the armament were studied and executed by Messrs. Orlando, agreeably to the wishes expressed by Comodoro Martin Rivadavia, of the Argentine navy. In the same dockyard at Leghorn is now in an advanced stage of armament another armored cruiser, the General Belgrano, also for the Argentine government.—*Engineering.*

[AUSTRIA.]

THE AUSTRO-HUNGARIAN TORPEDO-BOAT BOA.

The Boa, sister ship to the Viper, and one of four vessels ordered by the Austro-Hungarian government in consequence of the results obtained with the latter, made an unofficial trial, or rather pleasure trip, from Greenwich Pier round the Nore lightship and back on Tuesday last.

The Boa differs but little from the Viper. She is, however, some 5

feet longer and 6 inches wider, being 152 feet 6 inches long, with 15 feet 3 inches in beam. She is propelled by a single screw driven by a three-cylinder triple-expansion engine, with diameters 18 inches, 26 inches and 39½ inches by 18 inches stroke. The engines are nominally of 2000 horse-power, and make at full speed some 340 revolutions per minute. Carrying a load of 44 tons, which brings her down to maximum service draught, she made on her three hours' official trial a speed of 24.265 knots, the steam pressure being 180 lbs. and the air pressure only ⅝ inch. This figure is particularly noteworthy; the ease with which the boilers make steam is quite remarkable. When running at some 15 to 16 knots at natural draught on Tuesday we found the firemen lolling and the fire-doors half open. The boilers are placed face to face. A description which we believe is practically correct for the present case will be found in the issue of *The Engineer* above referred to. We note from that that the heating surface is 1868 square feet in each boiler, and the grate area 35 square feet in each. The boilers are, of course, of the Yarrow type, and have two fire-doors and a common grate each. The pressure fan is placed horizontally in the raised "roof" of the stokehold, and is driven by means of a vertical shaft by a small single engine placed on the floor of the hold. The bunkers on each side of the hold carry sufficient coal to give a radius of action of 1500 knots at 10-knots speed. Her armament consists of three 18-inch swivel torpedo tubes—two placed on each side of the bow some distance behind the turtle-back and one at the stern; and two 3-pounder quick-firing guns mounted on pedestals almost touching the conning tower on either side, and consequently just behind the turtle-back. Rails for the transport of the torpedoes run all around the deck.

The vessel is constructed throughout of mild steel, about ⅛ inch thick, the plates for the hull proper being galvanized. It will probably be noticed by our readers who turn up the description of the Viper's trials that she reached a maximum speed of 26.786 knots, making 386.46 revolutions per minute. They must not, however, overlook the fact that the Viper carried then only 26 tons, whereas the Boa, as we have already said, carried 44 tons. There can be no question that the latter vessel with a decreased load could attain approximately the same speed as her sister, although her horse-power is no greater and her length and beam are increased.

The vessel ran for the greater part of the time at a nominal half-speed, or thereabouts, between 12 and 15 knots, and at that speed there was absolutely no vibration, and even on the short spurts at higher speeds, which were made when more open water was reached, only a slight tremor was appreciable. This result has, we believe we are correct in saying, been attained without the introduction of any special balancing arrangements other than those secured by a careful proportioning of the weights of reciprocating parts.—*The Engineer*, Sept. 23, 1898.

[BRAZIL.]

On the 18th June the new battle-ship Marechal Deodoro was launched from the Chantiers de la Seyne, near Toulon, for this government. The Deodora and her sister ship the Floriano are small ironclads of only 3162 tons displacement, but in their way they are formidable little vessels. Their dimensions are as follows: Length, 267 feet 6 inches; beam, 48 feet; draught, 13 feet 2 inches. The engines are to develop 3400 I. H. P.,

giving a speed of 14 knots under natural draught and 15 knots under modified forced draught; the boilers will be water-tube, on the Lagrafel and D'Allest system. Protection is afforded by a complete water-line belt of Harveyized steel, 5 feet deep, of which 2 feet is above the water at ordinary draught; the thickness of the upper part of this belt amidships is 14 inches, and of the lower part 6 inches, while the whole belt tapers at the extremities to 4 inches; there is also a 1.5-inch armored deck, extending the whole length of the ship. The two turrets are protected by 8.2-inch plates of hardened steel, and work inside a barbette protected by 7-inch steel, into which lead the armored ammunition tubes, etc. The armament consists of two 24-centimetre (9.4-inch) Armstrongs, mounted in the turrets, one forward and one aft, with an arc of training of 250 degrees; the turrets can be worked either by hand or electricity, while the ammunition hoists are also worked by electricity; there are four 4.7-inch Q. F. guns in small casemates, protected by 2.9-inch armor—one on each beam immediately abaft the fore turret and one on each beam immediately before the after turret, with two 6-inch howitzers, mounted one forward and one aft on the spar deck, and six 6-pounders and 1-pounder Q. F. guns, with two submerged torpedo-tubes. The conning tower is protected by 4-inch armor, as are also all the combings of the openings through the armored deck.

The torpedo cruiser Tamoyo, of 1000 tons displacement, 7000 I. H. P. and 23 knots' speed, was launched from the Germania Yard at Kiel on the 26th May. She is 269 feet long, with a beam of 28 feet 10 inches, and her armament will consist of two 3.9-inch, six 2.2-inch, two 1.4-inch guns (all Q. F.), with two machine guns.—*Le Yacht.*

[CHINA.]

A 35.2-KNOT TORPEDO-BOAT.

A cable dispatch says that the extraordinary record 40.8 miles an hour was made at the second trials of the torpedo-boat destroyer Hai Lung, just built at Elbing, Germany, by the Schichau works for the Chinese government. The runs were made in the open sea between the light-houses at Pillau and Brüsterort, which are 19 knots apart. The wind was fresh (five by the scale) and there was considerable sea on. The Hai Lung, according to the *Kölnische Zeitung*, traversed the course several times, the average time for the runs being 32 minutes 28 seconds, which gave a speed of 35.2 knots, or 68 kilometers, or 40.8 statute miles. This exceeds by far any speed heretofore made on the water, surpassing even the best performance of the Turbinia.—*Scientific American.*

[ENGLAND.]

LAUNCH OF H. M. S. OCEAN.

The Ocean, battle-ship, was launched at Devonport on July 5th by Princess Louise, Marchioness of Lorne, in the presence of enormous crowds of spectators. Great interest was taken in the event at Devonport and throughout the neighborhood, and excursion trains were run by the railway companies from various parts of Devon and Cornwall. Twenty-five thousand persons are officially estimated to have entered the dockyard.

The naming ceremony was successfully performed by the Princess, and

she was then presented by Rear-Admiral Carr with a mallet and chisel enclosed in a handsomely carved box which had been made in the dockyard. Then came a weary and anxious period of waiting. According to the programme the launch should have taken place at 5.30, but it was not effected until twenty minutes past six. The delay was due to the fact that earlier in the day the vessel had begun to slide down. It was found at two o'clock that she had moved ½ inch, and it was then decided to replace the blocks which had been removed in readiness for the launch. The ship then settled down upon the blocks, and when the time came for launching her it was found necessary to split them up. Owing to the rising tide two or three blocks became submerged and could not be removed, and the Ocean cut these up as she passed over them into the water. The cord holding the weights by which the dogshores were to be knocked away was severed by Princess Louise at twenty minutes past six, just as the tide was at its height, and the vessel at once slid gracefully into the water amid the cheers of the thousands of spectators.—*The Engineer.*

H. M. S. Amphitrite.

The Amphitrite is 435 feet in length between perpendiculars, but the overhanging stern and the projecting ram make the length over all 463 feet. Her beam over the sheathing is 69 feet, and her moulded depth to the upper deck is 39 feet 9 inches. The mean load draught of the vessel is 25 feet 3 inches, at which draught the displacement is 11,000 tons. The hull of the vessel is constructed of Siemens-Martin steel, the heavy external framing of the bow and stern as well as the propeller brackets and the rudder frame being phosphor-bronze castings. The rudder is of the balanced type, and the stern curved outwards under the water, so as to form a formidable ram; up to a height of about 9 feet above the water line the steel shell of the vessel is sheathed with teak planking and coppered. Two long bilge keels to prevent rolling are also fitted. The vessel's bottom, amidships, is constructed on the cellular principle, the inner skin being carried from the protective deck at one side down and up to the protective deck at the other side. The double bottom is minutely sub-divided into water-tight compartments. By water-tight bulkheads and water-tight flats the vessel is thoroughly closely subdivided. The protection consists of a curved armored deck of steel plating 4 inches thick at the crown, which extends the whole length of the vessel. Under this deck, which is raised in way of the engines, are also placed the steering engines and gear, the capstan engines, the air-compressing machinery, and all the magazines, shell-rooms and torpedo-rooms. The coal bunkers, which have a capacity of over 2000 tons of coal, are arranged along the sides of the boiler-rooms and along the sides of the vessel on the protective deck above the engines and boilers.

The armament of the vessel, as will be seen from the statement, is of a most powerful description. There are sixteen 6-inch quick-firing guns, twelve 12-pounder quick-firing guns, three 3-pounder quick-firing guns, two 12-pounder boat and field guns, and eight 0.45-inch Maxim machine guns. The 6-inch guns are mounted as follows: Two on the forecastle head, two on the upper deck aft, the remaining twelve being mounted on the broadside in armored casemates constructed of Harveyed steel armor, 6 inches thick. Of these twelve casemates, eight are on the main deck level and four on the upper deck level. The 12-pounder guns are mounted

four on each broadside on the upper deck, two on the upper deck under the forecastle and two right aft on the main deck. The 3-pounder guns are mounted on the boat platform deck. The Amphitrite is fitted with two under-water broadside torpedo tubes, placed under the protective deck in a special compartment forward. The 6-inch guns and 12-pounder guns will be supplied with ammunition through armored tubes, extending from the protective deck to the deck on which the guns are worked. An ammunition passage is arranged on each side of the ship, extending for the whole length of the machinery space below the protective deck. The passage is completely protected by coal on top, sides and bottom, so that the ammunition need never be exposed to gun-fire in its course from the magazines to the guns.

The conning tower is placed forward and is built of Harveyed steel armor 12 inches thick. From it are led voice pipes, telegraphs, etc., down through a forged steel tube 7 inches thick to the protective deck, and forward and aft underneath this deck to the engine-room, torpedo-rooms and steering positions. Above the conning tower is a navigating bridge with chart-room, steering standard, telegraphs, etc., required in the ordinary navigating of the ship. The vessel is fitted with two steel masts. Unlike her larger sister ship, the Powerful, these are not fitted with fighting tops, but on the top of the mainmast pole is fitted large semaphore signalling apparatus. There are five steam steering positions, one on the forward navigating bridge, one on the aft bridge, one in the conning tower, and two under the protective deck. Efficient hand gear is also fitted aft under the protective deck.

The vessel is lighted throughout with electricity, there being three dynamos supplying six powerful searchlights and the incandescent lights, which number about 850. The searchlights are placed one in special top on each mast and two on each bridge. The ventilation, both natural and artificial, is most complete; there are four large ventilating steam fans for ventilating the main spaces of the ship, and one electric fan for cabin ventilation. On the deck are arranged two boat-hoisting engines and two coal-hoisting engines, heavy derricks being also fitted for hoisting the boats inboard and over the side. The boats, which are fourteen in number, include a 56-foot steam pinnace and two steam launches, which are stowed on a steel boat deck, extending from the forecastle to the after bridge. The total complement of the vessel, including the admiral's retinue, will be 718 men, for whose comfort every provision is made. The officers' quarters, which include a spacious suite for the admiral, are arranged mostly on the main deck abaft the machinery, the crew and petty officers being accommodated.—*The Engineer*, July 15, 1898.

H. M. S. Albion.

The battle-ship Albion, the launch of which lately was attended by a terrible catastrophe, is a vessel of the Canopus class which has been built by the Thames Iron Works and Shipbuilding Company, at Blackwall, to the order of the government. Like others of her class, she is 390 feet long between perpendiculars, 74 feet wide, and will have a draught of water 26 feet, at which her calculated displacement is nearly 13,000 tons. The order for the Albion and her sister vessels was given out in July, 1896. The other ships of the class originally ordered are the Canopus, built at Portsmouth, the Goliath at Chatham, the Ocean at Devonport, and the Glory at Laird's, Birkenhead. A sixth ship, the Vengeance, was

added to the class after the navy estimates for 1897 had been first put forward, the cost of her construction for the year being included in an additional half-million asked for when the shipbuilding vote came on in the House somewhat late in the session. The last-named vessel has been put out to contract with Messrs. Vickers, Sons and Maxim, at their newly-acquired yard, once the property of the Barrow Shipbuilding Company.

According to the official programme the Albion was not to have been launched before July, but circumstances which have been considered of sufficient importance by the Admiralty have hastened the event. As a consequence the ship is in a very unfinished state. Little of the armor is in place, and the casemates are mostly not in position. The belt armor is of 6-inch Harveyed steel and extends over a length of 196 feet, protecting the side for 5 feet below and 9 feet above the water-line. It is backed by 4 inches of teak and has also two thicknesses of ½-inch plating. At the ends of this protected length are athwartship bulkheads, also of Harveyed steel plates, 12 inches, 10 inches and 8 inches in thickness. These join the two sides of the belt and connect also with the two barbettes which form positions for the principal armament. The arrangement of the armored deck is similar to that now adopted by the Admiralty for battle-ships, the deck being joined at its outer edges to the bottom of the belt, but having transversely sufficient rise to bring the central part 2 feet 6 inches above the water-line. The main and middle decks are also protected by plates ½ inch and 1 inch thick. The 6-inch guns are mounted in casemates in the way now usual for guns of this nature, having 6-inch armor at the sides; whilst inboard they are partitioned off by a double thickness of 1-inch plating. The forward and after casemates are sponsoned out sufficiently to allow a line of fire directly ahead in the case of the forward guns and directly astern in the case of the after guns, the angle commanded in both instances being 120 degrees. The barbettes are armored on the upper parts with 12-inch Harveyed steel plates, the lower tiers of plates, which are behind other armor, being 6 inches thick. For protection of the guns in the barbettes there are 8-inch Harveyed steel shields. The ends of the ships of this design are partially protected by 2-inch nickel-steel plates being worked outside the skin plating from the forward bulkhead to the stem, and from the after bulkhead to the stern. This forms what is practically a continuation of the belt of extended area.

The main armament consists of four 12-inch wire-wound guns of 46 tons each. These will be mounted in pairs in the barbettes upon turntables, and have the now usual "all-round" loading arrangements. There are twelve 6-inch quick-firing guns placed each in a separate casemate, eight being on the main deck and four on the upper deck. There are ten 12-pounders, six being on the upper deck amidships and between the two 6-inch guns on each broadside, whilst four are placed on the main deck, two right forward and two right aft. There are also six 3-pounder Hotchkiss guns, these being distributed between the two military tops on each of the two masts. There are also two 12-pounder guns for boat and landing purposes, eight 0.45-inch Maxim automatic guns and six howitzers. The torpedo tubes are submerged and are four in number, two being well forward and two aft. They are for 18-inch torpedoes, of which 14 will be carried for firing from the ship, whilst five 14-inch torpedoes will be supplied to be launched from the dropping gear fixed to the steam pinnaces.

The machinery is being made by Messrs. Maudslay, Sons and Field, of

Lambeth. The twin-screw engines are of the usual triple-expansion type, the cylinders being 30 inches, 49 inches and 50 inches in diameter, the stroke being 4 feet 3 inches. At 108 revolutions per minute, the horse-power developed is estimated to be 13,500, which corresponds to a speed of 18½ knots. The high and intermediate pressure cylinders have piston valves, the low-pressure cylinder having flat slide valves. All are driven by double eccentrics and double bar links. Each cylinder is supported by four columns of H-section standing on cast-steel main bearing frames. The same contractors are supplying a good deal of the auxiliary machinery, including feed pumps, compressing machinery for supplying air jets to the furnaces and compressed air for other purposes, hot-well pumps, fire and bilge pumps, fans, air compressors, electric-light engines, steering engines, etc. The boilers are of the Belleville type, having economizers, as in the Diadem's boilers. It may be remarked that these are the first British battle-ships in which it has been decided to put Belleville boilers. There are 20 of these boilers, but only two chimneys. The boilers are arranged in three groups and are fired fore and aft. The boiler pressure is to be 300 lbs. per square inch, but this will be reduced to 250 lbs. at the engines by the reducing valves usual with Belleville boilers. The total heating surface will be 24,155 square feet for the large tubes of the boilers proper and 11,560 square feet for the smaller tubes in the economizers. The total weight of main and of auxiliary with water in boilers, etc., is estimated at 1290 tons.

It will be seen from the above that the Albion is not so powerful a ship on paper as the vessels of the preceding class, of which the Magnificent was the first launched. In the first place, she is about 2000 tons less displacement, and her armored belt is not so thick by 3 inches, is over 100 feet shorter, and 1 foot less depth. It is said, however, that improvements in the manufacture of armor plating have resulted in giving an equal resistance for the modern 6-inch belt as was possessed by the 9-inch armor of the Magnificent, although, it must be remembered, the latter was of Harveyed steel. The new ship has, however, the additional protection at the ends, which will be good at anything like close range against light projectiles only. The barbettes of the Canopus class have also 12-inch armor in place of the 14-inch of the Magnificent. If we compare the thickness of armor with that of the Royal Sovereign we find a still greater disparity, for the latter ship had an 18-inch belt, but that was not Harveyed steel plating. The four guns of the main armament are of the same weight in both the Magnificent class and the Canopus class, a fact which must be put to the credit of a smaller ship; and the same thing may be said of the 6-inch quick-firers and their casemates, of which 12 are provided in each design; but the lighter guns are more numerous in the older design, there being sixteen 12-pounders.

The mounting of the 6-inch guns at either end of the battery, to which reference has already been made, gives the Canopus class a very powerful bow or stern attack. The two 46-ton guns in each barbette have been estimated to discharge, within the space of five minutes, eight rounds, the energy of which would be 264,160 foot-tons. The four 6-inch quick-firers at the ends of the battery, on the upper and main decks—which, as stated, can be trained in a line parallel to the keel—would fire 25 rounds each in the same time, and that would add a striking energy of 335,600 foot-tons to the total, so that two 6-inch guns are more than equal in this respect to the guns of the main armament. The two 12-pounder quick-firers which could be brought to bear right ahead or astern would

fire about 75 rounds each in the five minutes, and that would add another 63,450 foot-tons. This would bring the total energy of fire right ahead or right astern to 663,210 foot-tons, which is considerably in excess of the Magnificent's power of attack in the same direct lines. Naturally, the broadside fire would not show the same preponderance for the later design, as the advantage is obtained only in the line of fire directly ahead or astern by the sponsoned mounting of the four 6-inch guns at each end of the battery. The weight of the 12-inch projectile is 850 lbs. and that of the 6-inch projectile is 100 lbs.

In regard to engine power, the Canopus class have the advantage, their estimated power being 13,500 indicated horse-power, which should be compared with the originally estimated 12,000 power with forced draught of the Magnificent, the computed speed of the latter having been 17½ knots. The Canopus class are therefore put down at a knot faster, and we believe 1000 extra horse-power was added to the legend when, after the original designs were got out, it was decided to compound the Belleville boilers, or fit them with what are known as economizers. The full coal capacity of the Magnificent is 1800 tons, or 100 tons less than that of the new ships.

Naturally it is not possible to make an accurate comparison of different designs without having knowledge of all the elements, and this complete information is known only at the Admiralty. We may, perhaps, safely conclude that no great sacrifice has been made of essential military features to secure the advantages that the new ships undoubtedly possess. Sir William White, therefore, appears to have even surpassed his former efforts, and Sir John Durston is likewise to be congratulated, for the additional power attained is one of the conspicuous features of the class.

There is one other feature of design to which reference may be made. Profiting by a melancholy experience, the style of ram bow applied to recent vessels has been framed on new lines. It is brought nearer the surface than was usual formerly, and is altogether of a more substantial nature, having more the appearance of the fore end of a bottle-nosed whale than the "spur" of the earlier ironclads. Being near the surface and of such substantial proportions would lead, one would think, to an appreciable addition to the wave-making resistance; but, on the other hand, the hole that it would make in an adversary would put the matter of further combat beyond the pale of reckoning. This massive ram has additional support to that formerly given in designs by the 2-inch bow armor of nickel steel, web frames, the armored deck, and a platform deck associated with a stiffening of steel 2 inches thick.

It is an interesting fact, which has been brought to our notice by Mr. J. M. Macrow, the naval architect who has for so many years been the chief professional officer at the Thames Iron Works, that on the slip from which the Albion was launched last Tuesday, the first iron war vessel built for the Royal navy was constructed 50 years ago. This was the Vulcan, a sister ship to the Simoon and the Megæra. She was designed as a steam frigate, but when well advanced it was determined that iron was not a suitable material to withstand shot and shell, so the Vulcan was transformed into a trooper. In the present day engineers may be apt to question the wisdom of the committee of naval officers who arrived at this decision, but it must be remembered that there is a vast difference between the iron skins of those days and the Harveyed plates of the Canopus class, or even the ordinary steel plates of to-day. As between the wood and iron construction of that era the naval officers

had common sense on their side. The Vulcan was originally engined by Rennies, having four-cylinder engines 49½ inches in diameter, the boiler pressure being 8 lbs. per square inch and the horse-power 793, the speed being 9½ knots. These engines were replaced by a pair of two-cylinder engines by Maudslay, the diameter of each being 64 inches, the steam pressure 10 lbs., and the horse-power 857, but the speed remained much as before, in spite of these advances.

We do not propose referring at any length to the sad accident by which so many lives were lost through the washing away of a bridge or raised gangway, caused by the wave from the launch. At the time of writing full details are not to hand, but these will be found in due course in the daily press. At present it would seem that the only persons to blame were the unfortunate people who put themselves, in spite of warning, in so dangerous a position.—*Engineering.*

H. M. S. Salamander.

Her Majesty's cruiser Salamander has just completed a series of official steam trials in the English Channel, off Plymouth harbor, to test the efficiency of her new water-tube boilers. In addition to the boilers, a complete set of auxiliary machinery has been fitted, consisting of four forced-draught fans, 6 feet diameter, driven by specially designed engines; two main feed pumps and two auxiliary pumps, with steam cylinders 9 inches diameter, pumps 6½ inches diameter, with a stroke of 9 inches, of the vertical duplex type—Mumford and Anthony patent—and four specially designed feed-water regulators, for the purpose of automatically insuring a constant and regular supply of feed-water to the boilers, also the joint patent of Mr. Mumford and Mr. Anthony. These we have fully described in the impression referred to above. The boilers, of which there are four, have each 2000 square feet of heating surface and 45 square feet of grate surface. They were designed to develop collectively 3500 horse-power under forced draught. The trials passed off in a most satisfactory manner, not a hitch occurring. On the eight hours' trial under natural draught the indicated horse-power developed was 2575. On the full-power run of three hours' duration the horse-power developed was 4114—far in excess of the specified amount; this was obtained with an air pressure in the stokeholds of 2.6 inches. The vessel attained a speed of twenty knots.—*The Engineer*, July 15, 1898.

The Steam Trials of H. M. S. Europa.

We gave in our issue of June 10 an illustration, with complete description, of the machinery of the first-class cruiser Europa, built and engined by the Clydebank Engineering and Shipbuilding Company, Limited, Clydebank, and supplementing that description we now give in tabular form an analysis of the important series of trials which the cruiser has just passed through. There were, in addition to the usual contract trials, tests to determine the full capabilities of the Belleville boiler under a moderate system of forcing. There were thus five trials, three of them of 30 hours' duration; and yet the series of steaming trials, which also included independent speed runs, were made within the minimum possible time, which is the best suggestion that everything went well. Indeed, no warship has ever gone through such a programme in such a short time with results so satisfactory, and Sir John Durston, K. C. B., the engineer-

in-chief of the navy, and Mr. John G. Dunlop, the engineering director at Clydebank, are to be congratulated.

The Europa, it may be said, is a first-class cruiser 435 feet long, 69 feet 6 inches extreme breadth, and at 25 feet 3 inches draught displaces 11,000 tons. She has a protective deck 4 inches thick right fore and aft, and her guns are either in casemates, or have nickel-steel shields. Her armament consists of sixteen 6-inch quick-firing guns, fourteen 12-pounder quick-firing guns, three 3-pounders, and eight Maxims, with two submerged torpedo-launching tubes. The engines are of the triple-expansion type, with four cylinders arranged in couples for balancing, the diameters being 34 inches, 55½ inches, 64 inches and 64 inches respectively, with a 4-foot stroke. The cooling surface is 17,500 square feet. There are 30 boilers of the Belleville type, with economizers. The grate area is 1450 square feet, the heating surface in the generators 29,620 square feet, and in the economizers 10,980 square feet, making a total of 40,600 square feet. These particulars will assist the reader in following the results given in the table. The ship belongs to the same class as the Diadem, whose trials we fully reported in January and February.

EUROPA: PARTICULARS OF TRIALS.

Date of Trial	June 1 and 2, 1898	June 3 and 4, 1898	June 7 and 8, 1898	June 10 and 11, 1898	June 13, 1898
Description of Trial	30 hours' coal consumpt'n at 3300 H. P.	30 hours at 12,500 H. P.	8 hours	30 hours' coal consumption with 24 boilers	4 hours' full power with 24 boilers
Heating surface in use.....sq. ft.	13,520, 10 boilers	40,550, 30 boilers	40,550, 30 boilers,	31,709, 24 boilers	31,709, 24 boilers
Grate " " ..... "	491	1462	1462	1143	1143
Ratio of grate to heating surface	1 : 27.53	1 : 27.73	1 : 27.73	1 : 27.73	1 : 27.73
Steam pressure in boilers.....	212	265	279	261	261 lb
Air pressure in stokeholds.....	.25 vacuum in smoke-boxes	.....	.....	.07	.6
Mean revolutions per minute.....	65.4	103.8	112.4	102.7	112.5
Mean indicated horse-power.....	3302	12,739	17,010	12,666	16,98
Coal burnt per indicated horse-power per hour..	2.24	1.94	Not taken	2.02	1.9
" " square foot of grate per hour	15	16.9	"	22.38	27.5
Indicated horse-power per square foot of grate..	6.72	8.71	11.63	11.08	14.5
Heating surface per indicated horse-power.....	4.09	3.18	2.38	2.5	1.9

The coal used was very inferior owing to the coal strike, and had been exposed to the weather without shelter in the dockyard for a long period. The coal consumption would otherwise have been lower.

It will be seen that the first trial was at one-fifth full power, when 10 boilers were in use, and here 3302 indicated horse-power was got for 65.4 revolutions, while the coal consumption was 2.24 lbs. per horse-power hour, which is satisfactory for this low power, especially in view of the fact that the coal used throughout the trial was very inferior, owing to the Welsh coal strike, a fact which should be carefully noted when comparing results. The second trial, also of 30 hours' duration, was at about 75 per cent. of the full power, with all the boilers in use, while the third was the full-power trial, of eight hours' duration, both of which gave satisfactory results alike in respect of power and consumption. The more important trials, however, are those given in the fourth and fifth columns of the table, when only 24 out of the 30 boilers were in use. These were extra trials undertaken at the request of the Admiralty authorities. In the one case the engines were required to develop 75 per cent. of the full power, and in the other the full power, or as much as possible. In the former case the power was got with only 0.07 inch of

air pressure in the stokeholds, and with a consumption of 2.02 lbs. of inferior coal. On the four hours' trial the boilers, with what used to be regarded as natural-draught conditions—an air pressure less than ½ inch—gave 14.25 indicated horse-power per square foot of grate, and yet only consumed 1.91 lb. per horse-power hour, although the rate of consumption was 27.23 lbs. per square foot of grate per hour. This result will be regarded as very favorable, indicating, as it does, that the ships of this class have that reserve of boiler power for full speed which does not characterize all the ships of the navy. It shows that two or three of the boilers may be placed *hors de combat* without affecting the speed of the ship.

The vessel also ran a series of trials at progressive speeds on the measured mile at Stokes Bay and over the deep-sea course from Dodman to Rame Head. The full speed of 20½ knots was easily got with the ship at full draught. On the trial of June 13 also the speed was tested by two runs over a 24-mile course, and showed a speed of 20.8 knots. The results confirmed those got with the Diadem, and added one more to the long list of successes by Sir William White, the Director of Naval Construction. In this connection reference may be made to the appointment of Mr. W. J. Luke, for several years an active member of Sir William's staff, as naval architect for the Clydebank Company. Mr. Luke, who was a distinguished student of the Naval College at Greenwich and, later, lecturer on naval architecture, has been, as an assistant constructor, closely identified with the design of first-class cruisers and the Queen's yacht, and there is a certain appropriateness in the last ship passed through his hands being the production of the company, of whose staff he is now an important member.—*Engineering.*

The Steam Trials of H. M. S. Niobe.

The accompanying table gives an abstract of the results of the official contract trials of H. M. S. Niobe, built and engined at the Naval Construction Works of Messrs. Vickers, Sons and Maxim, Limited, at Barrow-in-Furness. The Niobe belongs to a class of which eight have been ordered, and the Amphitrite, launched lately from the same works, is also one of the eight. The Diadem and Europa, which have also passed through their trials, are also of the same class. There is no need to describe the ship, which is of 11,000 tons displacement; but it may be said that the engines are of the triple-expansion type with two low-pressure cylinders, and with four cranks. The high-pressure cylinder is 34 inches; the intermediate, 55½ inches; and the two low-pressures each 64 inches; with a stroke of 48 inches. There are 30 Belleville boilers, and the designed full power was 16,500 indicated horse-power. The contract conditions, which were easily excelled, were a trial of 30 hours' duration at one-fifth full power, a 30 hours' trial at 75 per cent. of the full power, and an eight hours' full-power run. The results of all three trials are appended:

Results of thirty hours' coal consumption trial at 3310 indicated horse-power, and 12,500 indicated horse-power, and eight hours' full-power trial at 16,500 indicated horse power:

		3300 I.H.P. Stbd.	Port.	12,500 I.H.P. Stbd.	Port.	16,500 I.H.P. Stbd.	Port.
Mean steam in boilers		200		258		263	
Mean steam at engines		147		220		235	
Mean vacuum		28.1	28.1	27.4	27.6	26.9	27.0
Mean revolutions		70.2	70.0	107.4	107.6	118.0	117.0
Mean pressure in cylinders	H. P.	30.8	37.8	88.0	86.9	106.6	106.5
	I. P.	14.6	12.8	35.4	36.5	37.7	39.3
	L. P.[1]	5.4	5.5	12.8	13.3	16.8	16.4
	L. P.[2]	5.1	5.0	12.2	12.8	16.0	15.9
Indicated horse-power	H. P.	477	583	2078	2065	2771	2742
	I. P.	603	525	2233	2303	2614	2721
	L. P.[1]	299	299	1073	1114	1556	1501
	L. P.[2]	280	275	1024	1071	1473	1456
Total indicated horse-power		1659	1682	6408	6553	8414	8420
Gross total indicated horse-power.		3341		12,961		16,834	
Coal per indicated horse-power		1.77		1.55		1.66	
Speed by log		12.3		19.33			
Speed over measured course				19.27		20.507	

The coal consumption comes out most satisfactory in all three trials, and particularly in the trial at 75 per cent. full power, which is supposed to be the most economical rate of steaming for the design of engine adopted. This 1.55 lbs. per horse-power hour, of course, includes the consumption for all the auxiliary machinery on board, without rating the power of these engines, which are usually very expensive in fuel. The engines ran during this trial, as with the others, with remarkable steadiness. The variations in the total power were confined within almost the limits of error, and during the night and morning watches the variations were between 12,997 and 13,170 indicated horse-power. The revolutions continued very steady between 107 and 108. Indeed, the whole machinery worked with all the steadiness and with the little attention which characterizes the tramp steamer rather than the warship. The weather was exceptionally fine and the trials followed each other as soon as the coaling arrangements permitted. The speed on the 12,500 indicated horse-power and full-power trials were taken on the measured distance between Rame Head and Dodman Point.—*Engineering*, July 9, 1898.

[FRANCE.]

THE FAST CRUISER CHATEAURENAULT.

This fine vessel was launched on the 12th May last; she was constructed by the Forges et Chantiers de la Seyne, and has a displacement of 8018 tons. From the first the intention has been to avoid giving the ship the man-of-war appearance so prominent in the American cruisers Columbia and Minneapolis, particularly in the form of the bow and stern. The profile adopted (it is easily understood to what end) is strictly that of the mail steamer. The straight stem, long run, overhanging stern and pole masts all combine to give the ship the pacific aspect of a large Atlantic greyhound. As regards sea-going qualities, the straight stem slightly

inclined inboard, in the opinion of seamen, is an advantage for a ship destined to maintain a high speed, if necessary, against a head sea. The disadvantage which the form of bow has in limiting the depression of the bow gun has been overcome, to a certain extent, by lowering the upper deck forward on the Chateaurenault. This allows of the gun being placed far enough aft to obtain a solid base without compromising the strength of the structure forward by the reactions of firing under a depression of about 5 degrees, which is considered sufficient. The rudimentary pole masts are fitted with the necessary signal apparatus, and two fixed platforms at their lower parts for electric light projectors. There are 4 funnels as on the Columbia; the casings do not extend higher than within about 5 metres of their tops, thus saving useless top weights and gaining stability. In her cross sections the upper works "fall home" somewhat. The ship has a forecastle and poop invisible from the exterior, the lines of the bulwarks being carried in an unbroken line fore and aft. During her construction the Marine Board decided to cover in the space between the forecastle and poop by a shelter deck, very light and completely free, which should serve as a roof to the upper deck, permit the crew to sleep under it, and at the same time form a promenade deck, altogether a very elegant and relatively peaceful arrangement, very appropriate to the special mission the Chateaurenault is designed to fulfil in time of war. The dimensions of the Chateaurenault, as compared with the Minneapolis, are as follows:

	Chateaurenault.	Minneapolis.
Length over all.....	139.45 m. (452 ft.)	
Length between perpendiculars..	135 " (442 ft. 10 in.)	125.08 m. (412 ft.)
Beam.....	17 " (55 ft. 9 in.)	17.72 " (58 ft. 2 in.)
Draught of water aft.	7.40 " (24 ft. 6 in.)	7.10 " (22 ft. 6 in.)
Displacement	8,018 tons	7,505 tons on trials 8,133 " maximum
I. H. P.....	23,000	21,000
Full speed, forced draught.....	23 knots (estimated)	22 knots (estimated 23.7 " on trials
Coal bunker capacity	2,100 tons	1,518 tons
Armament	2—164.7 mm. (6.4 in.) Q. F. 6—138.7 " (5.5 in.) Q. F. 10— 47 " (3-pdr.) Q. F.	1—203 mm. (8-in.) 2—152 " (6-in.) Q. F. 8—102 " (4-in.) Q. F. 12— 57 " (6-p.) Q. F. 4— 37 " (1-p.) Q. F.

The artillery of the American ship is therefore superior as regards the number of guns, but on the other hand the Chateaurenault is better provided with stores and coals. This would appear to be preferable for a ship of which the first requirements are speed and radius of action, and the latter in the case of the French ship is about 10,500 miles at 12 knots. In fact, such as it is, the artillery of our fast cruisers appears to be sufficient to give them the advantage over any auxiliary armed cruiser, and their speed to protect them against the cruisers of any enemy superior in armament and protection. The armament of the Chateaurenault is disposed as follows: The two 164.7-millimetre guns are on central pivot

mountings, one on the poop and one on the forecastle; six 138.7-millimetre, of which four are in redoubts on the upper deck forward and aft, and two on sponsons in the central part of the ship; while ten 47-centimetre are distributed above the redoubts and at the ends of the ship. All these Q. F. guns are served from magazines placed directly under them, the hoists being worked, as we shall see later, either by hand power or electricity. As regards speed, we know that the American cruisers have not fulfilled the expectations formed of them after their brilliant trial performances. For reasons which we have frequently explained in this journal, we are better secured in France against these discrepancies in trial and actual service speeds. We can, therefore, confidently hope that the Chateaurenault will have in reality a speed superior to that of any foreign ship of the same class. It would cause no surprise either if the estimated speed of 23 knots should be sensibly exceeded in the trials. The constructors of Les Chantiers de la Seyne are thoroughly capable, and it is satisfactory to know that the lines of the Chateaurenault have been studied by M. Lagane, so that we may be convinced their fineness and perfection will contribute to the highest possible success in the matter of speed. The propelling apparatus consists of three triple-expansion engines, each with its own propeller; the minimum power to be developed being 23,000 I. H. P. at about 124 revolutions per minute. The evaporative apparatus, which was originally intended to comprise boilers of the Lagrafel-d'Allest type, will now be constituted of fourteen Normand-Sigaudy boilers with small tubes, divided into four unequal groups, three of four boilers each, and one of two right forward. The engine and boiler-rooms will occupy about half the total length of the ship; the total weight is about the same as that of the Minneapolis, 1950 tons. The marked difference in the weights forming the displacement of these two ships lies in the protection and coal supply. The armor protection in the Chateaurenault is to that of the Minneapolis as 6 to 10; the coal supply, on the other hand, of the Chateaurenault is nearly double that of the other ship. This comparison confirms the impression that the French ship is more truly a corsaire than cruiser in the military sense of the word than is her American contemporary. The zinc boxes in the compartments of the cofferdams have been omitted by the order of the board, and the cofferdams modified in consequence. The turtle-back armor deck, which is 2.5 inches thick, has its centre about 0.95 metre above the water-line, sloping at the sides to 1.40 metres below it. The guns are protected by fixed redoubts and revolving shields, both 2 inches thick, as provided in the design. With the exception of the boat-hoisting gear, consisting of four steam winches of 3000 kilogrammes, everything is worked by electricity, or by hand-power in case of injury, including guns, ammunition, steering-gear, etc. The electrical energy is furnished by four dynamos, of 80 volts 600 ampères, of which one can be held in reserve, the other three being quite capable to supply all services. There are twelve electric hoists for ammunition, distributed as follows: Two for the 164-millimetre, six for the 138.6-millimetre, and four for the 47-millimetre guns. The electric stearing gear can be worked indifferently from the bridge, conning tower or central position. There are also three electrical Rateau ventilators, three Peruisse order transmitters from the conning tower to engine-rooms, and six projectors, controllable at a distance. These projectors are arranged, one on the platform on each mast, four surface-sweeping arranged lozenge-fashion; those on the beam

and the one forward are on a moving carriage, the one aft and those on the masts of fixed pedestals. The dynamos also supply the current for the bow and position lights, lamps and reflectors for working at night, and about 450 incandescent lamps, from 10 to 60 candle-power each. We see, therefore, that there is a very large application of electrical power on board the Chateaurenault. It is hardly necessary to add that in the matter of accommodation and comfort there is absolutely nothing to be desired; the ventilation has been well studied, and excellent conditions of habitability may be confidently expected. It was intended that the Chateaurenault should carry a rear-admiral and staff, but the idea has been abandoned. She will carry 2 superior officers, 15 junior, 10 cadets, 50 petty officers, 114 stokers, mechanics, etc., and about 500 bluejackets. The ship is to be completed by the 8th July, 1899, at Toulon, having been laid down on 23rd May, 1896. She was launched with her protective deck completed and her upper works well advanced. She will be completed by Les Chantiers de la Seyne with all dispatch, and her construction will be a great honor to the firm.—*Royal United Service Institution.*

Engines of the French Armored Cruiser Chanzy.

The French armored cruiser Chanzy was launched in 1894 and was completed some two years later. She belongs to the Amiral Charner type, and the group comprises four ships—the Charner, Bruix, Chanzy and Latouche-Treville—the last named having been launched in 1892. The Chanzy is built wholly of steel, and is 110 metres long (360 feet 10 inches), 14 metres beam (45 feet 11 inches), and 6 metres (19 feet 8 inches) draught. The displacement is 4750 tons, and the indicated horse-power of the engines is 8300. There are two screws, and the speed attained is 19 knots. The armored protection of all four vessels is similar, and consist of a belt of 95 millimetres (3.74 inches); turrets protected with the same thickness; and an armored deck of 50 millimetres (1.97 inch). The armament is as follows: Two 19-centimetre (7.47 inch) guns; six of 14 centimetres (5.51 inches) quick-firing; four 65-millimetre (2.56-inch), also quick-firing; four similar guns of 49 millimetres (1.85 inches), and six machine guns.

The main engines, which were built by Messrs. Schneider & Co., of Creusot, are horizontal three-cylinder triple-expansion, each driving a propeller. The principal dimensions are the following: Diameter of high-pressure cylinder, 0.800 metres (31½ inches); diameter of mean-pressure cylinder, 1.200 metres (47½ inches); diameter of low-pressure cylinder, 1.900 metres (74 $\frac{3}{4}$ inches); stroke, 0.9 metre (35 $\frac{7}{16}$ inches).

Each engine is provided with a condensing installation, consisting of a wrought-brass tubular condenser, two single-acting vertical air pumps, and a centrifugal circulating pump. The pumps are worked by a separate engine.

All the slide valves are cylindrical; the high-pressure cylinder is fitted with one, while the mean and low-pressure cylinders have each two. The steam distribution motion is on the Marshall system.

The reversing gear, which is worked by hand and by steam power, allows of regulating the degree of admission of steam in the cylinders. The pistons are of cast steel and conical in shape. The foundation plates on which rest the crankshaft bearer-blocks are also of cast steel; the bearer-blocks are, moreover, fitted to the cylinders by forged-steel cross-bars. All the crankshafts, intermediate and propeller shafts are hollow,

of forged steel; the propellers are of special brass, cast in one piece. Each engine-room is provided with a ventilator. The condensed water discharged by the air pumps of each engine is collected in a tank provided with filters through which it passes before going to the boilers. Special evaporators serve for the production of fresh water for the feed make-up; the boilers are thus fed entirely with fresh water. There are 16 boilers of the Belleville type, as prescribed by the French navy for this cruiser, placed in two stokeholds and ending in two funnels. Registered pressure, 17 kilos. (241.8 lbs. per square inch); total grate area, 64.50 square metres (694.3 square feet); total heating surface not covered by water, 1814 square metres (19,526 square feet).

The boilers are fed by eight pumps of the Belleville type. The stokehold ventilation and the working under forced draught are insured by eight ventilators. The maximum total power prescribed was 8300 indicated horse-power, with a maximum pressure of 12 kilogrammes (170.7 lbs. per square inch) at the valve chests. At the trials the following results were obtained:

Duration of trial.....hours	3	2	6	24	8
Number of engines working.....	2	2	2	2	2
Number of boilers working.....	12	16	8	16	16
Average revolutions	112.4	118.6	80.5	104.2	115
Total power realized.....horse-power	7385	8765	2386	5405	7482
Coal consumption per horse-power per hour..... kilos.	0.965	0.936	0.644	0.809	0.791
Coal consumption per horse-power per hour..... lbs...	2.18	2.06	1.42	1.78	1.75

—*Engineering*, September 16, 1898.

[SWEDEN.]

SWEDISH NAVY.

We do not hear very much of the Swedish navy, and are apt to altogether overlook the steady and persistent fashion in which this is being made into a homogeneous fighting force. It now consists of six battleships, second class, five of which are ready for sea. The newest, Oden, Thor and Njord, though nominally 16-knot vessels, will be nearer 17 knots, the Oden having done 16.8 knots at sea for six hours. They are of much the same type as the Norwegian Elswick-built Harald Haarfagre and Tordenskjold, and, so far as appearance goes, differ chiefly only in that they have two funnels fore and aft instead of the big one of the Norwegian. A comparison is as follows:

	NORWEGIAN.	SWEDISH.
Displacement	3400	3400
Dimensions..	274½ × 48½ × 17½	279 × 49 × 16½
Complement.		210
Guns.....	Two 8-in. Q. F. Elswick	Two 9 8 Canet
	Six 4.7-in. Q. F.	Four 4.7 Q. F. (six in two of the ships)
	Six 12-pounders	
	Six 1-pounders	Ten 6-pounders
	Two submerged torpedo tubes	One submerged torpedo tube
Armor.....	Belt 8 in. to 4 in. (= 16 in. to 8 in. iron) Harveyized steel	Belt 13 in. to 4 in. (= 15 in. to 5 in. iron) steel.

Both ships have armored gun-houses and armored bases to them. The gun-houses of the Haarfagre are 8-inch Harvey. There is some uncer-

tainty as to the thickness of those in the Oden type; probably they do not exceed 8 inches, and may be less. They are apparently not of hardened steel. The smaller guns of the Haarfagre are all behind shields, while those of the Oden type are in a 5-inch armored battery. As regards speed, the Haarfagre has a continuous sea speed of about 14 knots; according to her officers her trial speed was 17.2 with natural draught. She may therefore be set down as a swifter vessel. Her coal supply is 200 tons, that of the Swede 300 tons. Both, of course, are low freeboard ships. It is difficult to decide between the vessels as to which is the better. It has already been stated in *The Engineer* that officers of the Haarfagre told ours that the Elswick design gave the ship four 4.7's only, and that two extra guns were added by request of the Norwegian Admiralty. The crews of these extra guns practically work underneath the men at the 12-pounders, unless their guns are trained directly on the broadside. It is possible to conceive of grave inconvenience from this. The battery of the Njord, sister to the Oden, must have her guns very crowded indeed. However, the new 4.7's as mounted on top of our Alexandra's battery are more crowded together still, though that ship has the advantage of a larger beam. There is no doubt that a single shell would clean out the Njord's battery; that of the Haarfagre, being in the open air, would be less likely to suffer so heavily from a solitary shell.

Turning to other Swedish ships, the Svea has had her 6-inch breech-loaders replaced by 4.7 quick-firers. The old monitor John Ericsson has been reconstructed, the old turret being converted into a barbette by opening the top. Inside this two 6-inch guns are mounted behind a thick shield. The old armored gunboats are mostly in hand for reconstruction, the Ulf and Berserk being already completed. The old gun has been replaced by a 4.7 quick-firer. With their light draught these little ships might be exceedingly useful. There is from 14 inches to 17 inches of laminated iron armor over this gun; it is probably fairly safe against anything less than a 10-inch gun. The catchers Ornen, Jacob, Bagge, Clas Horn and Clas Uggla are either ready for sea or nearly so.—*The Engineer.*

[UNITED STATES.]

LAUNCH OF THE ILLINOIS.

In the launch of the battle-ship Illinois at Newport News, October 4, the Navy has the beginning of an important addition to its strength. The launch was successful in every way, Miss Leiter saying in a clear and ringing voice, "I christen thee Illinois," as she swung a bottle of champaign against the battle-ship. The Illinois has a length on load water-line of 368 feet; beam, extreme, 72 feet 2½ inches; draught on normal displacement of 11,525 tons, 23 feet 6 inches; maximum displacement, 12,325 tons; maximum indicated horse-power (estimated), 10,000; probable speed, 16½ knots; normal coal supply, 800 tons; full bunker capacity, 1400 to 1500 tons; complement of officers, 40; seamen, marines, etc., 449. These data show that the necessity for speed which the experience of this war has forced upon us was not appreciated fully when the Illinois was designed. She represents the highest development of what even now must be considered the old American notions.

In armament she is strikingly powerful. Four 13-inch guns in two

turrets, placed in the centre line; fourteen 6-inch R. F. guns, sixteen 6-pounder, four 1-pounder, two Colt and two field guns, make a heavy battery. She will carry four torpedo tubes. The 13-inch guns have an arc of fire of 270 degrees and the 6-inch an arc of 90 degrees on the broadside, and those on the upper deck have a direct fire ahead and astern.

The armor belt, which extends from the stem to abaft the after turret, is to be 16½ inches thick at the top and 9½ inches thick at the bottom, tapering to four inches at the stem. The diagonal armor is 12 inches thick. The protective deck is carefully designed, being 2¾ inches on the flat, 3 inches on the slope forward and 4 inches abaft the turrets. The turret armor is 17 inches front and 15 inches back and sides. The barbettes for the turrets will be 15 inches on the front and 10 inches on the rear and sides, and the casemates will have 5½-inch armor. Two conning towers are provided, one 7 by 11 feet, 10 inches thick, and one 6 feet diameter and 6 inches thick.

The height of freeboard forward is 20 feet and at the stern 13¼ feet. The floor of the pilot house is 44 feet high. The sight holes in the conning tower are 34½ feet above the water. The forward 13-inch guns will have an elevation of 26½ feet, the after guns 19 feet, the 6-inch guns from 15 to 22½ feet, and the 6-pounders from 30 to 40½ feet above water. Smaller guns are mounted in the military tops at heights of from 59 to 79 feet. All these dimensions indicate both seaworthiness and great fighting range. Four searchlights are provided.

There will be two sets of triple-expansion, twin-screw engines, in separate water-tight compartments. The indicated horse-power will be about 10,000, with 120 revolutions per minute; stroke, 4 feet. There are eight single-ended cylindrical boilers, each 15½ feet in diameter by 9 feet 11¼ inches long, having a total grate surface of 685 square feet, with 21,200 square feet of heating surface; pressure, 180 pounds. These boilers are placed, two each, in four separate water-tight compartments. The smoke pipes are two, and stand abreast of each other.

The first keel plate of this vessel was laid February 10, 1897, not quite twenty months ago, and the work completed to date is between 53 and 54 per cent. The price was $2,595,000, and the date of completion is announced as October 5, 1899. Her sister ship, the Wisconsin, will be launched from the Cramps' shipyard next month, and another, the Alabama, will follow from the Union Iron Works, San Francisco.—*Army and Navy Journal*, Oct. 8, 1898.

Obituary.

HERMAN G. DRESEL.

It seems fitting that the pages of the *Naval Institute* should render some tribute to the memory of one who for a number of years gave thoughtful and conscientious attention to its issues. It seems further fitting that this tribute should be more than a mere recount of routine services, for in the death of Lieutenant Herman G. Dresel the Navy of the United States has not only lost a sound-thinking man, but also a man of action, one who only lacked the opportunity to prove himself both brave and daring.

It was the good fortune of the writer to have been thrown with the deceased for nearly two whole cruises and a year or so of shore duty. Intercourse only served to increase a love for him as a man and an admiration for his intellect. Accomplishments so varied and withal so modestly hidden are rarely found in any one individual. Be the subject art, science, sport or technical knowledge of his profession, he was equally at home.

He had a conservative of approaching a subject which quite deceived the listener as to the degree of his familiarity with it. Should his listener prove well found, however, he jumped quickly from an attitude of inquiry to one of mastery of the subject and defined his position in strong and concise arguments. His manner on these occasions was vigorous, aggressive, but withal considerate, and no one could engage in a serious discussion with him without becoming better informed or forced to admire the fence of his antagonist.

As a musician he quite outclassed the skilled amateur; as a natural scientist, he was an acute observer and a well-equipped collector; as a linguist, he spoke two foreign languages well and was conversant with two others; as an instructor in mathematics, he was noted for his thoroughness and intense interest in his

work; as a sportsman he was both skillful and enthusiastic, while his conspicuous activity in athletic matters brought him close to those who have followed the career of the Navy in such matters; his association with the Naval Institute covered one of the most successful periods of its career; his reputation as an officer was of the best.

He was ambitious for service where his courage could be proven; he was restless under restraint; he never could tolerate a conservative spirit in such matters. He was chivalric, high toned, generous, and his untimely death must be attributed to that fierce war which the elements of high-strung natures frequently wage with one another, especially at times when ambition and high hopes seemed to have failed of recognition.

No profession can afford to lose so versatile a man, especially when the essentials of that profession are so well met, and when death called upon us, among the living, to erase the name of Herman Dresel from the Navy rolls, we silently registered in our minds the name of another victim to that stagnation in naval matters which has so often subordinated the strong to the weak, the sensitive to the indifferent, the genius to the commonplace.

Affections are not altogether out of place even in a warlike profession, and a man who can arouse real affection, even among a few of his associates, must be regarded with that consideration which is due to men of mental power, and in rendering this incomplete and necessarily hasty tribute to the memory of a dear friend and shipmate, I confess my thorough love for him as friend and companion, my admiration for him as an officer, gentleman and scholar.

C. H. Harlow, Lieutenant, U. S. Navy.

ESTABLISHED 1780.

WALTER BAKER & CO.'S

Breakfast Cocoa

TRADE-MARK.

Pure, Delicious, Nutritious.

Costs Less than ONE CENT a Cup.

Baron von Liebig, one of the best-known writers on dietetics, says:—

"It is a perfect food, as wholesome as delicious, a beneficent restorer of exhausted power; but its quality must be good, and it must be carefully prepared. It is highly nourishing and easily digested and is fitted to repair wasted strength, preserve health, and prolong life. It agrees with dry temperaments and convalescents; with mothers who nurse their children; with those whose occupations oblige them to undergo severe mental strains; with public speakers, and with all those who give to work a portion of the time needed for sleep. It soothes both stomach and brain, and for this reason, as well as for others, it is the best friend of those engaged in literary pursuits.

"Walter Baker & Company, of Dorchester, Mass., U. S. A., have given years of study to the skilful preparation of cocoa and chocolate, and have devised machinery and systems peculiar to their methods of treatment, whereby the purity, palatability, and highest nutrient characteristics are retained. Their preparations are known the world over and have received the highest endorsements from the medical practitioner, the nurse, and the intelligent housekeeper and caterer."—*Dietetic and Hygienic Gazette.*

Be Sure that the Package Bears our Trade-Mark.

WALTER BAKER & CO. LIMITED,

DORCHESTER, MASS.

BIBLIOGRAPHIC NOTES.

ARMY AND NAVY JOURNAL.

JULY 2, 1898. The Invasion of Cuba. Casting Heavy Projectiles. Our Civil War and the Cuban War. The Military Situation. The Battle of Siboney. Improvements in High Explosives. Three New Battle-ships.

JULY 16. History of the Navy. The Ventilation of the Boiler-room. Springfield Guns and Smokeless Powder. The Merchant Marine in War.

JULY 30. The Small-calibre Bullets. Destruction of Cervera's Fleet.

AUGUST 13. The Naval Programme.

AUGUST 20. The Future Navy.

AUGUST 27. The System of Naval Rewards. Navy Personnel. The Spanish Wrecks. The Marine Corps.

SEPTEMBER 3. The Greek Fleet in War.

SEPTEMBER 10. The Pigeon Service on the New York.

SEPTEMBER 17. The Hits on Spanish Ships. The Battles before Santiago. Carrier Pigeons in War. The Brown Segmental Wire Gun.

SEPTEMBER 24. Modern Small Arms.

OCTOBER 8. Launch of the Illinois.

OCTOBER 15. Reorganizing the Navy Personnel. The Coast Signal Service. The New Navy Guns.

OCTOBER 22. Naval Ordnance. Report of Chief of Ordnance. The Navy in Defense of the Army. Our Enlisted Strength Afloat. The Dum Dum Bullet.

OCTOBER 29. Official Report of Rear-Admiral Sampson. The Artillery at San Juan.

ARMY AND NAVY REGISTER.

JULY 2, 1898. Naval Reorganization.

JULY 16. Victory at Santiago. Report from the Oregon. Rear-Admiral Sampson's Report of the Destruction of the Spanish Fleet off Santiago. General Breckinridge's Report on Santiago Campaign. Compensations of the War.

AUGUST 13. Army and Navy at Santiago. Report of Marines in Cuba. Report of Major-General Jos. Wheeler.

AUGUST 20. Report on Cervera's Ships.

AUGUST 27. The Absolute Need of Artillery.

SEPTEMBER 3. Reports from the Gloucester. The Value of Battle-ships.

SEPTEMBER 17. Reports on the Santiago Campaign.

SEPTEMBER 24. The Coming Garrisons in Cuba. The Marines. The New Monitors.

OCTOBER 1. Reorganization of the Army.

CASSIER'S MAGAZINE.

JULY, 1898. Protection of British Commerce in War. The Ram in Modern War Fleets. A Chapter in the History of War Shipbuilding in Great Britain and France. Torpedo Attacks. Power Transmissions of American Warships. Aerial Torpedoes. Torpedo-boat Designs.

AUGUST. Coal Supply, Speed, Guns and Torpedoes in Modern War. Heavy Ordnance for Coast Defense in the United States. The Indentification of Warships, and Firing Discipline. Hardening Projectiles by Gas. Raising Sunken Vessels. Miscellaneous Torpedo Vessels.

SEPTEMBER. Torpedo Guns Afloat and Ashore. Speed as an Element of Warship Design. Naval Repair Ships. Projectiles for Modern Naval Ordnance.

OCTOBER. Torpedo-boats in Modern Warfare.

ENGINEERING NEWS AND AMERICAN RAILWAY JOURNAL.

JULY 7, 1898. Buildings of the Omaha Exposition. The Naval Victory at Santiago. Recent Experience with Torpedo Destroyers.

JULY 14. The Increase in the World's Principal Navies. Lessons of the Santiago Battle to Naval Designers.

JULY 21. The Armor of the Spanish Cruisers Sunk at Santiago. The Demand for Faster Battle-ships.

JULY 28. Comments on the Naval Battle at Santiago.

AUGUST 4. The Machinery of the New Torpedo-boats and Torpedo-boat Destroyers. The Position of the United States Assistant Engineers.

AUGUST 11. The Sims-Dudley Pneumatic Gun. The Value of Secondary-Battery Fire in Naval Battles.

AUGUST 18. Gun-fire Analysis of the Santiago Fight.

AUGUST 25. The 1500 H. P. Engines for the Berlin, Germany, Electric Works.

SEPTEMBER 1. Admiral Sampson's Opinions upon the Lessons of the Santiago Naval Battle.

OCTOBER 20. The Coast Signal Service during the War.

THE IRON AGE.

JUNE 30, 1898. The New Battle-ships. Contraband of War. A New Method of making Hard-faced Armor.

JULY 7. A New Method of making Hard-faced Armor. Test of an Experimental Boiler.

JULY 28. British Shipbuilding. Modern High Explosives. Swift Battle-ships. A New Quick-fire Naval Gun.

AUGUST 11. The Boilers and Bulkhead Doors of the Chicago. Trial of New Torpedo Nets.

AUGUST 18. The Carnegie Krupp Armor Plate. The New Battle-ships.

AUGUST 26. The Torpedo-boats.

SEPTEMBER 1. Test of 10-inch Krupp Armor Plate.

SEPTEMBER 8. The New Battle-ships.

SEPTEMBER 15. Torpedo-boat Contracts Let.

SEPTEMBER 22. A Defense of the Torpedo-boat.

SEPTEMBER 29. The Carnegie Krupp Plate.

OCTOBER 6. Aluminum as a Reducing Agent and a Source of High Temperature. The Contracts for the Monitors.

OCTOBER 27. Steam Turbine in England. Japanese Shipbuilding. Naval Ordnance. Lessons from the War to Warship Machinery.

JOURNAL OF THE UNITED STATES ARTILLERY.

MAY AND JUNE, 1898. Moving Targets in Use in the Light Artillery of England, Germany, France and Italy, and some Forms recently tried by the Light Artillery Battalion at Fort Riley, Kansas. The Krupp 7.5-cm. Rapid-fire Gun in the Cuban Campaign. Contributions to the Study of the Probability of Fire of Coast Artillery. Howitzers and Mortars for Field Artillery to supply a Need of Curved Fire. Sharpnel-fire from Field Howitzers and Mortars.

JOURNAL OF THE MILITARY SERVICE INSTITUTION.

JULY, 1898. Reply to General Porter (articles). Magnetic Qualities of Gun Steel. American Grasses and Herbage. The Care of the Soldier in Camp. The Abbott Mortar Battery.

SEPTEMBER. Independent Patrols. Preventable Diseases. Telescopic Sights. Battle under New Conditions. Military Discipline.

JOURNAL OF THE AMERICAN SOCIETY OF NAVAL ENGINEERS.

AUGUST, 1898. Recent Performances of the U. S. S. Oregon. Water-tube Boilers. Experiments on the Compression of Steam

in the Clearance Space. Investigation of Distortion and Resistance of Flat Heads. Vickers' Guns. The Stettin Floating Graving Dock. The Tropenas Process of Steel Casting. Protection of Steam-heated Surfaces. The Problem of Combustion in Water-tube Boilers and a Means of its Solution. The First Battle between Modern Armorclads.

McCLURE'S MAGAZINE.

JULY, 1898. President McKinley in War Times. God and the Pagan. The First Fight on Cuban Soil. The Fastest Vessel Afloat. The Military and Naval Glory of England. The Fighting Strength of the United States. America Revisited in War Times.

AUGUST. Cover designed by Kenyon Cox. The Liner and the Iceberg. In Ambush. Love in Fog. While the Evil Days Come Not. Military Europe. A Midsummer Night's Trip. My Ride across Cuba. Reminiscences of Men and Events of the Civil War.

SCIENTIFIC AMERICAN.

JULY 2, 1898. Spanish Forts. Disappearing Gun-carriage. Spanish Submarine Torpedo-boat. Submarine Torpedo-boat.

JULY 9. Army and Coast Defenses. Courage in Modern Warfare. Reinforcement of the Dewey Squadron.

JULY 16. Analysis of American and Spanish Warships. The Cruiser Brooklyn. The Destruction of Cervera's Fleet. The Floating Machine Shop Vulcan. The Care of Wounded in Sea Fights.

JULY 23. Campaigning in the Tropics. England and the American Navy. Fall of Santiago. Lessons of the Santiago Naval Engagement. The Reconstructed Cruiser Newark.

JULY 30. Destruction of a War Balloon. The Remains of Cervera's Fleet. The Megaphone in War. Naval Smokeless Powder Factory. San Juan and its Defenses. The First Spanish Flag captured at Manila. The Present Status of the United States Navy.

AUGUST 6. To Prevent Collisions during a Fog at Sea. Higher Speed for our New Battle-ships. Spain's Losses on the Sea. Our Army and Navy Hospital Ships. The 3.2-inch Driggs-Seabury Field Gun. Admiral Sampson's Report of the Santiago Engagement.

AUGUST 13. Spain's Lost Opportunities.

AUGUST 20. The Percentage of Hits in Warfare. Guns, Ancient and Modern, at Santiago. The Colomes Life and Ship Protector. The Texas in Action.

AUGUST 27. The New Smokeless Powder for Army and Navy. Test of a 6-inch Experimental Krupp Plate.

SEPTEMBER 3. Return of the Victorious Fleet from Cuba.

SEPTEMBER 10. The Official Report of the Wrecked Spanish Warships.

SEPTEMBER 24. The Largest Floating Dock in the World. Rapid-fire Guns and Ammunition Supply in the United States Navy.

OCTOBER 1. New Troop Ships for the Army. A 35.2 Torpedo-boat. Protected Cruiser Philadelphia of the United States Navy. Explosion of Submarine Mines in Baltimore Harbor.

OCTOBER 8. The Limitations of the Torpedo-boat. The Uniform of the Soldier. Saving the Maria Teresa.

OCTOBER 15. Our Latest Battle-ship. The Uniform of the Sailor. The Revival of American Shipbuilding.

TECHNOLOGY QUARTERLY AND PROCEEDINGS OF THE SOCIETY OF ARTS.

JUNE, 1898. The Constitution of Steel considered as an Alloy of Iron and Carbon. The Reliability of the Dissociation Values determined by Electrical Conductivity Measurements. On the Best Resistance for a Sensitive Galvanometer.

SEPTEMBER. On the Telescope Mirror-Scale: Adjustments and Tests. Results of Tests made in Engineering Laboratories. The Protection of Steam-heated Surfaces. Review of American Chemical Research.

SEABOARD.

MAY, 1898. Increase of the Navy. Cost of Naval Unpreparedness.

JUNE 23. Dynamite in Naval Warfare.

SEPTEMBER 8. Ocean Liners as Warships. Voyage of the Monterey.

SEPTEMBER 15. Chief Constructor Hichborn's Views on the Navy and the Lessons learned in the War with Spain. The New Dry Dock at Newport News.

SEPTEMBER 29. Latest Type of Monitors.

OCTOBER 20. The Armored Cruiser Brooklyn's Damages.

UNITED SERVICE GAZETTE.

JUNE 25, 1898. The United States and Spain. The coming Probable Superiority of Foreign over British Torpedo-boats. The French Navy Estimates. Our Future Naval Policy. The Soudan Campaign.

JULY 2. Cost of Administration of the Admiralty and War Office. Minor Naval Needs. The Royal Military College. The Evolution of Small Arms and Machine Guns. The United States and Spain.

JULY 9. Destruction of Cervera's Fleet. Speed and Signalling.

JULY 16. The War. The Manning of the Navy.

JULY 23. The United States and Spain.

JULY 30. The Strength of the Army. Lessons of the Tirah Campaign. The Moral Welfare of the Soldier. The Naval Programme. The United States and Spain.

AUGUST 13. The Destruction of Cervera's Fleet (Official Report). The Manning Question. Inland Defenses.

AUGUST 20. Lessons of the War. The Marines and the Navy. The American Soldier.

AUGUST 27. Coaling at Sea. Battle Forts and Exterminators. The Soudan Campaign. Vickers' 3-inch 12½-pounder Quick-firing Field Equipment.

SEPTEMBER 3. The Soudan Campaign. The American Navy. The Morals of the Army. Foot Gear of Infantry Soldiers. Naval Gun-fire at Santiago. Soldiers on Cycles. Naval Prize Money.

SEPTEMBER 10. The Victory in the Soudan. The Action of Explosives on Guns. Coaling Stations.

SEPTEMBER 17. The Nile Expedition. Britain's Vitality. Admiralty Survey of Plymouth Sound and the Hamoaze. The Uses of Balloons and Kites. Liquid Fuel.

SEPTEMBER 24. The New American Battle-ships. The New Japanese Battle-ships. Imperial Policy. The Scope of the Marine Forces. The Wounds produced by Modern Small-bore Bullets. The Powerful.

OCTOBER 1. The Effect of the Gun-fire at Santiago. Naval Discipline. Wire-wound Guns.

PROCEEDINGS OF THE ROYAL ARTILLERY INSTITUTION.

JULY, 1898. The Advantages and Disadvantages of Q. F. Guns for Artillery in the Field (Silver Medal Prize Essay). The Advantages and Disadvantages of Q. F. Guns for Artillery in the Field (Silver Medal Prize Essay, 1898).

AUGUST. The Services of Lieut.-Colonel Francis Downman, R. A., in France, North America and the West Indies, between the years 1758 and 1784. The Artillery in the Rebellion of 1798.

SEPTEMBER. The Services of Lieut.-Colonel Francis Downman, R. A., in France, North America and the West Indies, between the years 1758 and 1784. Quick-fire Guns for Field Artillery. The Development of Armor during the years 1893-98. On the Word "Gonne" or Gun. Practice Seawards.

OCTOBER. The Services of Lieut.-Colonel Francis Downman, R. A., in France, North America and the West Indies, between the years 1758 and 1784. Morris Tube Practice. The Develop-

ment of Armor during the Years 1893-98. Q. F. Artillery-fire. Observations on Mr. Kinglake's Narrative of the Bombardment of Sebastopol in April, 1855.

ENGINEERING.

JUNE 24, 1898. The Destruction of the U. S. Battle-ship Maine. Messrs. Schneider & Co.'s Works at Creusot. Armor Plates. Shipbuilding and Shipping in Japan.

JULY 1. The Steam Trials of H. M. S. Europa. The Destruction of the U. S. Battle-ship Maine.

JULY 8. Messrs. Schneider and Co.'s Works at Creusot, No. XXIV. The Defenses of Hong Kong. The Steam Trials of H. M. S. Niobe. The Destruction of the United States Battle-ship Maine. Boiler Explosion at Bradford.

JULY 15. Messrs. Schneider and Co.'s Works at Creusot, No. XXV. The Argentine Cruiser General San Martin. Electric Launch for the Russian Government. Safety at Sea. The Destruction of the United States Battle-ship Maine. Criticism of the Navy. The Whitehead Torpedo.

JULY 22. Messrs. Schneider and Co.'s Works at Creusot, No. XXVI. Naval Machinery. Submarine Telegraph Enterprise.

JULY 29. Messrs. Schneider and Co.'s Works at Creusot, No. XXVII. The Navy Programme. An Old Warship.

AUGUST 5. Messrs. Schneider and Co.'s Works at Creusot, No. XXVIII. Reserves for the Royal Navy.

AUGUST 12. Messrs. Schneider and Co.'s Works at Creusot, No. XXIX. Submarine Telegraph Property. The Phillipine Islands. The Cost of Armor.

AUGUST 19. The Hospital Ship Solace.

AUGUST 26. Messrs. Schneider and Co.'s Works at Creusot, No. XXX.

SEPTEMBER 2. Messrs. Schneider and Co.'s Works at Creusot, No. XXXI. Barbette Carriage for the U. S. 10-inch Breech-loading Rifle. Willard Water-tube Marine Boiler.

SEPTEMBER 9. Messrs. Schneider and Co.'s Works at Creusot, No. XXXII.

SEPTEMBER 16. Engines of the French Protected Cruiser Chanzy.

SEPTEMBER 23. Messrs. Schneider and Co.'s Works at Creusot, No. XXXIII. Torpedo-boats for the Austrian Navy.

SEPTEMBER 30. Messrs. Schneider and Co.'s Works at Creusot, No. XXXIV. The Steam Trials of H. M. S. Terrible.

OCTOBER 7. Messrs. Schneider and Co.'s Works at Creusot, No. XXXV. The French Naval Manœuvres of 1898. Collisions at Sea. Naval Engineers and the Efficiency of the Navy. Safety Valve and Gate Valve.

OCTOBER 14. Messrs. Schneider and Co.'s Works at Creusot. The Erosion of Gun Tubes.

THE ENGINEER.

JUNE 24, 1898. The Jane Naval War Game at the United Service Institution. The Launch of H. M. Battle-ship Albion. The Engines of H. M. S. Albion. Combustion in Water-tube Boilers.

JULY 3. Lord Dundonald's Machine Gun. Triple-expansion Marine Engine. Colt's New Machine Gun.

JULY 8. The Evolution of Small Arms. Launch of H. M. S. Amphitrite. The Speed of Warships.

JULY 15. The Largest Storage Battery in the World. The New Graving Dock of the Clyde Navigation Trust. H. M. S. Salamander. The Naval Battle at Santiago. Hydraulic Propeller Starter. H. M. S. Amphitrite.

JULY 22. Aluminum as a Rival of Copper and Brass for Electrical Conductors. Quick-fire Guns for Artillery in the Field.

JULY 29. Lord Charles Beresford on the Russian Naval Programme. Vickers' Quick-fire Field Gun. Propeller Shafts.

AUGUST 5. High-pressure Marine Engines. Trial of Mumford's Water-tube Boilers.

AUGUST 12. The French Naval Defense. Shipbuilding and Marine Engineering on the Thames in the Victorian Era, No. XXI. The Engines of H. M. S. Amphitrite. Manchester Ship Canal. American Gunnery.

AUGUST 19. The Miyabara Water-tube Boiler. Borchardt Automatic Repeating Pistol. The Training of Engineers in Japan.

AUGUST 26. Smoke as a Factor in Naval Action.

SEPTEMBER 2. Shipbuilding and Marine Engineering on the Thames in the Victorian Era, No. XXII. High-speed Steam Engines. Trial of Carnegie Krupp Plates.

SEPTEMBER 9. Water-tube Boilers and the Manning of Stokeholds. Warships in Action.

SEPTEMBER 16. Ships of War in Action. Shipbuilding and Marine Engineering on the Thames in the Victorian Era, No. XXIII.

SEPTEMBER 23. The Austro-Hungarian Torpedo-boat Boa. American Electricity Supply Engines.

SEPTEMBER 30. Shipbuilding and Marine Engineering on the Thames in the Victorian Era, No. XXIV.

THE INSTITUTION OF MECHANICAL ENGINEERS.

NOVEMBER, 1897. Experiments upon Propeller Ventilating Fans, and upon the Electric Motor driving them. Diagram Accounts for Engineering Work.

JULY. High-speed Self-lubricating Steam Engines.

THE STEAMSHIP.

JULY, 1898. Marine Boiler Explosions. The "Universal" Valve Facing Machine. Burnett's Patent Generator and Water Circulator. The Problem of Combustion in Water-tube Boilers. Transmission of Heat through Plates from Hot Gases to Water. The Value of the Modern Torpedo-boat Destroyer. Launch of H. M. S. Highflier. The Problem of Combustion in Water-tube Boilers and a Means of its Solution. United States Gunboats. The Trial of H. M. S. Terrible.

AUGUST. Marine Boiler Explosions. Special Service Vessels of the U. S. N. Launch of British Warships.

SEPTEMBER. Electric Lighting on Board Ship. Marine Boiler Explosions. Electrically Controlled Searchlights. The Bretel Boiler Fluid. New Type of Steamer. The Indicator and its Uses on board Ship. The New Battle-ships for the British Navy. Re-boring a Steam Cylinder. The British and French Navies. High-pressure Marine Engines. The Chemistry of Boiler Waters. A Chapter in the History of War Shipbuilding in Great Britain and France. A Ship's Skin.

OCTOBER. The Indicator and its Uses on Board Ship. Shipbuilding in Japan. To Scrape Ships' Bottoms. Speed as an Element of Warship Design. A New Wreck-raising Vessel. Diversity in British Steam Engine Design. Marine Boiler Explosions. The Machinery Equipment of a Modern Battle-ship.

TRANSACTIONS OF THE INSTITUTION OF NAVAL ARCHITECTS.

VOL. XL, 1898. Recent Trials of the Cruiser Diadem. Riveting by Electricity. Investigation of the Nature of Surface Resistance of Water and of Stream-line Motion under certain Experimental Conditions. Horse-power Absorbed by Skin Friction and Wave-making of Different Forms and Proportions deduced from Progressive Trials. Experiments on the Effect of Direction of Rotation in Twin Screws. On Resistance to the Motion of Solids in a Fluid. Reminiscences of Early Marine Steam Engine Construction and Steam Navigation in the United States of America from 1807 to 1850. Description of some Experiments with a Water-tube Boiler. A General Theory of the Oscillations of a Ship on Waves. On Stresses Experienced by a Ship in a Sea Way. The Problem of Stability in Naval Architecture. The Steering Qualities of the Yashima. Submarine Torpedo-boats: their Influence on Torpedo-boat Architecture and Value in Warfare. On the Direct Attachment of Copper Sheathing Plates to the Hull of Vessels.

MINUTES OF PROCEEDINGS OF THE INSTITUTION OF CIVIL ENGINEERS.

VOL. CXXXII, 1897-98. The Machinery used in the Manufacture of Cordite. On the Thermal Condition of Iron, Steel and Copper when acting as Boiler Plate. Corrosion of Iron and Steel Plates and Tubes. The Contract Trials of the United States Gunboats Vicksburg and Newport. The Spanish Cruiser Cristobal Colon. Value of Artillery-fire in Naval Battles.

VOL. CXXXIII. Dry Rot and its Prevention. The Use of Steel for Pontoons. New Graving Dock, Glasgow. Report of Committee on the Thermal Efficiency of Steam Engines.

MARINE RUNDSCHAU.

JUNE, 1898. Treaty between Germany and China regarding the Cession of Kiantschou. Strategic View of the Mediterranean (continuation). A German Seamanship published in 1705. The Resistance of Ships in Canals. The Statistical Sanitary Reports of the United States and British Navies. The Destruction of the Maine. The American-Spanish War. The Turbine Propeller and Engines. The German Fleet as viewed from an Oldenburg Standpoint. Naval Notes.

JULY. Strategic View of the Mediterranean (continuation). The Preparation and Equipment of the Boats of the German Squadron for Blockade Duty on the East Coast of Africa, 1888-89. Military Sea Transports. The German North Pole Expedition in the Fishing Steamer Helgoland. The Distillation and Purification of Sea Water. German Armor Plates and Guns. The American-Spanish War. Naval Notes.

AUGUST AND SEPTEMBER. The Distillation and Purification of Sea Water (continuation). Outlines of the Sea Policy of the German Order of Knights. Naval Progress in the Last Decade. The Organization of the Brazilian Navy. The American-Spanish War (continuation). The Squadron of Admiral Cervera. Foster's Method of Finding the Ship's Position by Altitudes of Two Stars. Strategic Review of the Mediterranean (continuation). Naval Notes.

NORSKOI SBORINK.

NO. 3, MARCH, 1898. Elements of the Armed Strength of Fleets. The Comparative Strengths of the Fleets of different Powers. Questions in Naval Strategy. Training of the Engineer's Force for the Navy. The Steamer Cherron of the Volunteer Fleet. Corrosion and Fouling of Ships. Additions to "Compensation of the Compass at Night and in Fog."

Notes: Results of Twenty Years' Shipbuilding in Spanish and other Fleets. Trial of the Spanish Torpedo-boat Destroyer Plu-

ton. New Rule for Promotion of Officers in the Japanese Navy. Accidents: Premature Explosion of Powder Charge upon British Gunboat Bouncer.

No. 4, APRIL. Homogeneity in the Composition of the Fleet. The Rôle of Torpedoes in Naval War (translation of Admiral Colomb's pages, "The Future of the Torpedo" in Royal United Service Institution). The French Naval Budget for 1897. Review of Present-day Ordnance. New Method of Manufacture of Armor. Recent and Present-day Types of British Marine Engines. Method of Hull Construction with reduced Supports of Framing. Navigation Notes and Problems: On a Mineral Deposit at the Bottom of the Sea in certain Parts of the Baltic.

Notes: The Spanish Cruiser Rio de le Plata.

No. 5, MAY. Contributions to the History of Military Events in the Far East, 1847-55. The Laws of Development of Naval Strength. Review of Present-day Ordnance (conclusion). Advances in the Construction of Ships' Machinery. Considerations upon the Raising of the Sunken Ironclad Gangout.

Notes: Wreck of the Maine in the Harbor of Havana (translation of official reports). Composition of the Naval and Military Forces of the Powers at War.

No. 6, JUNE. The Question of Privateering. The Comparative Strengths of the Fleets of different Foreign Powers. The Composition of the American Navy in 1897. The Composition and Distribution of Ships' Artillery. Advances in the Construction of Ships' Machinery (conclusion). Practical Problems in the Computation of Sections of Wiring for Electric Installations. Notes on Marine Meteorology.

Notes: The Spanish-American War. General Position of Affairs. The Battle of Manila. Journal of the War.

No. 7, JULY. Considerations upon the Question of the Unsinkability of Ships. Strategical Importance of the Sandwich Islands (extracts from Captain Mahan's book). Sketch of the Development of the Japanese Navy. The Tactical Rôle of Ships' Artillery. Naphtha Fuel for Warships. Practical Problems in the Computation of Sections of Wiring for Electric Installations (conclusion). Puddling Steel and its Application to the Production of Cast Steel. Extracts from Journal of Admiral Kouznetsov.

Notes: The Spanish-American War. General Position of Affairs. Journal of the War.

No. 8, AUGUST. Navigation and its Influence on the Development of the Russian Empire. The Question of Privateering. The Latest Shipbuilding Programme. German Navy. The Tactical Rôle of Ships' Artillery. Dimensions of different

Parts of Steel Ships. The du Temple Water-tube Boilers. Puddling Steel and its Application to the Production of Cast Steel.

Notes: German Naval Manœuvres, 1897. Shipbuilding Abroad.

J. B. B.

MILITÄR WOCHENBLATT.

No. 56.

No. 57. The Influence of Target Practice in Developing the Fighting Efficiency of Infantry. Russian Military Strength in Eastern Asia. The Increase of the English Army. Minor Notes.

No. 58. The Battle near the Athsea River, Soudan. The Proposed Increase of the Salaries of Russian Officers. Minor Notes.

No. 62. Observations on the Organization of the Field Artillery. French Troops along the German Frontier. Minor Notes.

No. 63. Observations on the Organization of the Field Artillery (conclusion). The Russian Detachment Manœuvres. Minor Notes.

No. 64. Infantry Target Practice Regulations. The Russian Detachment Manœuvres. Minor Notes.

No. 65. The Importance of Rapid-fire in Battle.

No. 66. French Views on Infantry Battle Firing. The Sanitary Condition of the English Army. Minor Notes.

No. 67. Archduke Charles of Austria. The Folding Bicycle and the Equipment of Bicycle Troops. The Engineer Troops of Spain. Minor Notes.

No. 68. The New German Military Punishment Regulations. Archduke Charles of Austria (conclusion). The Exhibition of the Military-Geographical Society of Turin. Minor Notes.

No. 71. Instruction in Estimating Distances. Promotion in the French Army. Review of the Latest Discoveries and Inventions in Military Science. Minor Notes.

No. 72. The Russian Army Manœuvres of 1898. The Hungarian Landwehr Schools for Officers. Review of the Latest Discoveries and Inventions in Military Science. Minor Notes.

No. 73. Review of the Latest Discoveries, etc. What is most Important in the Training of Cavalry for Field Service. Minor Notes.

No. 75. The Great Exhibition of Russian Horses in St. Petersburg, 1898. Minor Notes.

No. 77. History of the Royal Army of Hanover. Blanketing Military Horses. Changes in the Organization of the Swiss Army. Minor Notes.

No. 78. Artillery-fire and Infantry Attack. The Storming of St. Privat. Minor Notes.

No. 79. The Pupils of the German Military Cadet Corps (a historical review). Policing Military Barracks. Minor Notes.

No. 80. Military Bicycles and Bicycle Troops. The Colonial Army of Portugal. Minor Notes.

No. 81. The Value of Coast Defenses in War. Minor Notes.

No. 82. War News from the United States.

No. 84. The Examination for Admission to the German Military Academy (a proposition). The Saxon Engineer and Pioneer Corps. The Grand Manœuvres on Salisbury Plain in England. Military News from Sweden. Minor Notes.

No. 85. The Examination for Admission to the German Military Academy (conclusion). Minor Notes.

MITTHEILUNGEN AUS DEM GEBIETE DES SEEWESENS.

Vol. XXVI, No. 8. The Navy in the Civil War of the United States, 1861-65 (continuation). The American-Spanish War, with Particular Consideration of the Naval Operations. Smokeless Nitroglycerine Powders. The Italian Fleet Manœuvres of 1897. The Naval Budget of Italy for the Fiscal Year 1898-99. Naval Notes: England, France, Germany, Italy, Russia, Holland, Norway, Portugal, United States, Chili and Japan. The English and Russian Fleets in Chinese Waters. The British Merchant Marine. Comparative Table of the Naval Strength of the Principal Sea Powers.

No. 9. The Navy in the Civil War of the United States, 1861-65 (continuation). The American-Spanish War, with Particular Consideration of the Naval Operations (continuation). Smokeless Nitroglycerine Powders (continuation). Session of the Mathematical Natural Science Class of the Vienna Academy of Sciences, June, 1898. The Naval Budget of Holland for 1898. Naval Notes: England, France, Russia, Italy, Spain, Portugal, United States, Argentine, Brazil, Chili, Japan, China, Morocco. The Burning of the Austrian Steamer North Erin. The Coal Production of the World.

No. 10. The Navy in the Civil War of the United States, 1861-65 (conclusion). The American-Spanish War, with Particular Consideration of the Naval Operations. The Austro-Hungarian Polar Expedition under Wayprecht and Royer, and the Nansen North Pole Expedition. Naval Notes: England, France, Germany, Italy, Russia, Portugal, Holland, United States, Argentine, Chili, Japan.

LE YACHT.

JUNE 4, 1898. The Protection of the Colonies.

By a decree of April 3, 1890, the civil governors of the colonies, under the direction of the minister for the colonies, are charged with the duties of the interior and exterior defenses of the distant colonies. Yet, as the writer remarks, in case of a disaster the navy would be held partly responsible for defeat. With Algeria it is different. There the general commanding the Ninth Army Corps, and the admiral commanding at Algiers, are under the authority of their respective ministers in what concerns the military and naval defenses of that dependency, and the writer goes on saying: Would it be unreasonable to ask for the recall of the decree of April 3, 1890, and give to those who would have to protect the colonies in the event of war the opportunity of preparing for their defenses in time of peace?

One thing is certain, and that is that at the present time those defenses are lamentably inadequate; and it could hardly be otherwise, the civil governors being exclusively absorbed by the economical (?) side of their administration. It is therefore upon the military commanders in the colonies that should devolve the duty and the right to directly inform in advance their respective authorized heads of the necessary preparations in regard to the land and sea defenses, supplies of all kinds, provisions and war materials, as well as to the personnel.

The land defenses should consist, as at home, of concrete works with armored shelters to withstand modern guns, as well as ground torpedoes, and blockade torpedoes, if advisable. Against such fortifications even armored battle-ships with their high-power guns would be powerless, exposed to serious injury, and would uselessly spend their ammunition, depleting their magazines, perhaps on the eve of a naval battle, as in the case of Sampson at San Juan of Porto Rico, with a negative moral effect.

It would be folly to depend upon fortifications of the kind Admiral Dewey reduced so easily at Cavite; better have none at all, thus depriving the enemy of the boast of an easy triumph. A simple mortar battery hidden from the sea and invulnerable would make the anchoring of a hostile fleet in roads like Manila Bay untenable.

Let us now examine the mobile defenses. In case of a conflict with a maritime nation some of our colonies would be subjected to a blockade, and as they are not self-supporting in the way of subsistence, the blockade would result in a famine, and finally in surrender. This is the danger that actually threatens the dependencies wrested from Spain, and what they need is a flotilla of small coast-defense torpedo-boats, or perhaps simple vedettes. This is the first requisite element of mobile defenses.

The Protected Cruiser d'Entreosteaux of 8114 Tons Displacement.

Length, 117 metres; extreme breadth, 7.15 metres; maximum power, 13,500; contract speed, 19 knots. The armament includes two 24-cm. guns in closed turrets, twelve 14-cm., eight of which are in armored barbettes and four on the spardeck; twelve 47-mm. and four 37-mm. placed on the bridges, besides six torpedo tubes, two of which are below the water-line. The military masts in the original contract have

been replaced by signal masts. The steam apparatus arrangements have also been modified to admit of compound firing. To that effect, an oil tank with a capacity of 40,000 litres has been built in the hold. The burners will be fed by Thirion pumps from special reservoirs. The electric installation comprises all the necessary organs for working the turrets, for the interior and exterior lights of all kinds, for transmitters of orders, ventilators, ash hoists, and hoists for ammunitions of all calibres. These are divided in two groups, one forward and one aft. The forward group, placed in the forward 240-mm. turret, comprises two engines, and the one in the after turret four. The incandescent lighting in the interior comprises 410 lamps of 10 candle-power each, and on the exterior 56 lamps, with an intensity averaging between 10 and 50 candles. There are six Maugin searchlights fitted with a distant electric command. The electric ventilators are of the Rateau, Sautier and Harlé system. Originally the six ash hoists were to be worked by steam, but are now worked by electricity or by hand. The electric ammunition hoists are three in number for the 37-mm. and 47-mm. projectiles, ten for the guns of 138.6 mm. and two for the guns of 240. All the command apparatus of these hoists are of the Savatier, Lagabbe, Sautter-Harlé system. Each turret is provided with an electric pump intended to remedy the leaks of the pivot-press. The pumps work automatically. The working system of the 240-mm. turrets is similar to that of the "tourelle battante"; the type of motors is Sautter and Harlé.

Everything has been done to make the habitability of the cruiser as complete as possible for officers and men serving in tropical seas.

Right aft, on the between decks, are the admiral's quarters, with salon, dining-room, pantry, bathroom, etc.; also the messroom of superior officers, officers' staterooms and other necessary rooms, and forward are the "corneaux" of the crew. All the partitions are of light-nerved sheet-iron, with the exception of the admiral's apartments' partitions. which are perfectly smooth to allow of decorations. The various articles of furniture, bedsteads, bureaux, desks, etc., are all metallic. The various magazines, provision-rooms, spirit-rooms, ammunition-rooms, coal-bunkers, etc., are all placed under the protective deck.

JUNE 11. The Rights of Neutrals and International Rights.

JUNE 18. Specialization of Cruisers: Express Cruiser (Croiseur estafette).

The estafette is intended to establish and maintain communication between armored cruisers detached from a squadron or a navy-yard for the purpose of discovering and following the enemy, and that squadron, or navy-yard, or whatever base of operations. It should also keep open communications between the metropolis and the near colonies in spite of a blockade, or the presence of a hostile fleet between France, Algiers and Tunis. Owing to the nature and importance of its rôle the estafette should be able to avoid any venture that might jeopardize its mission. That condition fixes its minimum speed, which can never be inferior to 23 knots.

Grounding and Floating of the Victorious.

No. 1059, JUNE 28. The Landing of Troops. Launching of the Brazilian Armored Cruiser Marechal Deodoro of 3162 tons.

No. 1060, JULY 2. Specialization of Cruisers: Commerce Destroyers (V. G.).

No. 1061, JULY 9. The Destruction of the Spanish Squadron off Santiago.

No. 1062, JULY 16. After the Naval Fight off Santiago (E. D.). The Cruiser Protet, built by the Forges et Chantiers de la Gironde.

No. 1063, JULY 23. Reorganization of the School of Higher Studies. The Mobile Defense of Bizerta.

No. 1064, JULY 30. The New Building Programme in England.

No. 1065, AUGUST 6. The Double-acting Manœuvres in the Mediterranean (E. Duboc).

No. 1066, AUGUST 13. The Combined Manœuvres of the North Squadron.

No. 1067, AUGUST 20. The Russian War Fleet.

No. 1068, AUGUST 27. American Official Report of the Naval Battle of Santiago.

No. 1069, SEPTEMBER 3. The English Armored Cruisers. The Protected Cruiser d'Assas.

No. 1070, SEPTEMBER 10. The New Naval Construction Programme in the United States.

No. 1071, SEPTEMBER 17. Living Conditions on Board Modern Men-of-war (continuation).

No. 1072, SEPTEMBER 24. The Merchant Navy and Shipyards.

After deploring the gradual and constant decline of the French merchant navy whilst those of her neighbors have increased—England's, 53 per cent.; Germany's, 107 per cent.; Spain's, 30 per cent.; Italy's, 57 per cent.—the writer points out a remedy. Create the commercial navy construction industry and reorganize the maritime credit are the two conditions *sine qua non* of the revival of the merchant navy, without which no nation can have an export trade, a prosperous industry or flourishing colonies, or foreign influence, and history points out that peoples that have devoted themselves to maritime commerce have become the masters of the world.

The Armored Battle-ship Bouvet of 12,200 tons. J. L.

REVUE MARITIME.

MAY, 1898. A Guide-book for Naval Officers and Sailors Travelling over French Railways. Lithologic Analysis of Marine Deposits taken from the Bay of Biscay. The National Hour.

Geographers, astronomers and seafaring people heard with undisguised surprise that the French Chamber voted without discussion a law making

the Paris meridian less 9 minutes 25 seconds the national hour for France. This, it will be noticed, corresponds with the Greenwich time. This same bill had previously been voted down, being strenuously opposed by the ministers of war, marine and public instruction respectively, as likely to involve regretable consequences. On the other hand, the adoption of the Greenwich meridian had been rejected in December, 1896, by the Geographical Society; and the Astronomical Society adopted a similar resolution at about the same time. It is hinted that the change is due to the railway and telegraph companies; but these companies will derive very little benefit from the change compared with the great inconvenience that will result to the general public.

Foreign Navies.

JUNE. The French Oceanographers (continuation).

See *Revue Maritime* of March, 1897, p. 443, and of Sept., 1897, p. 542.

Foreign Navies. Coast Defenses, translated from the Italian. The Fighting Ships of the Future.

An interesting study of modern ships published in the *Marine Rundschau* of July, 1897, and reproduced at length in the *Revue*.

JULY. Gymnastics of the Sailor. Free use of the Flag in Naval Warfare. The Necessity for a Reform. J. L.

McClure's Magazine

$1.00 a year - - - - - - 10c. a copy

FOR 1899

Among the special features are

A NEW SERIAL BY RUDYARD KIPLING

THE LATER LIFE OF LINCOLN
BY MISS IDA M. TARBELL

THE NAVAL SIDE OF THE WAR, BY CAPT. MAHAN

A TELEGRAPH OPERATOR'S LIFE—REAL EXPERIENCES AND ADVENTURES

Contributions by the highest authorities on new developments in

SCIENCE, INVENTION, EXPLORATION

Embracing articles descriptive of

- A Plunge in the Diving Torpedo Boat
- Submarine Navigation
- The Kite in Modern Warfare
- Telegraphing without Wires
- The Marvels of the Sea
- Unsolved Problems of Astronomy
- Life in the Deepest Mines
- What Peary is Doing in the Arctic
- The Telectroscope—Pictures by Telegraph

SPLENDID SHORT STORIES

They will come from such writers as:

Rudyard Kipling	Robert Barr	Sarah Orne Jewett
William Allen White	John A. Hill	Octave Thanet
Hamlin Garland	Cutcliffe Hyne	Sarah Barnwell Elliott
Stephen Crane	Morgan Robertson	E. Nesbit
Shan F. Bullock	Clinton Ross	Ellen Glasgow

We shall publish a number of very striking stories by new writers, and also a number of those short, crisp, dramatic episodes from real life which our readers have come to know as a special feature of McClure's.

THE S. S. McCLURE COMPANY

200 East 25th Street

NEW YORK CITY NEW YORK